DECEMBER 1949

Journal

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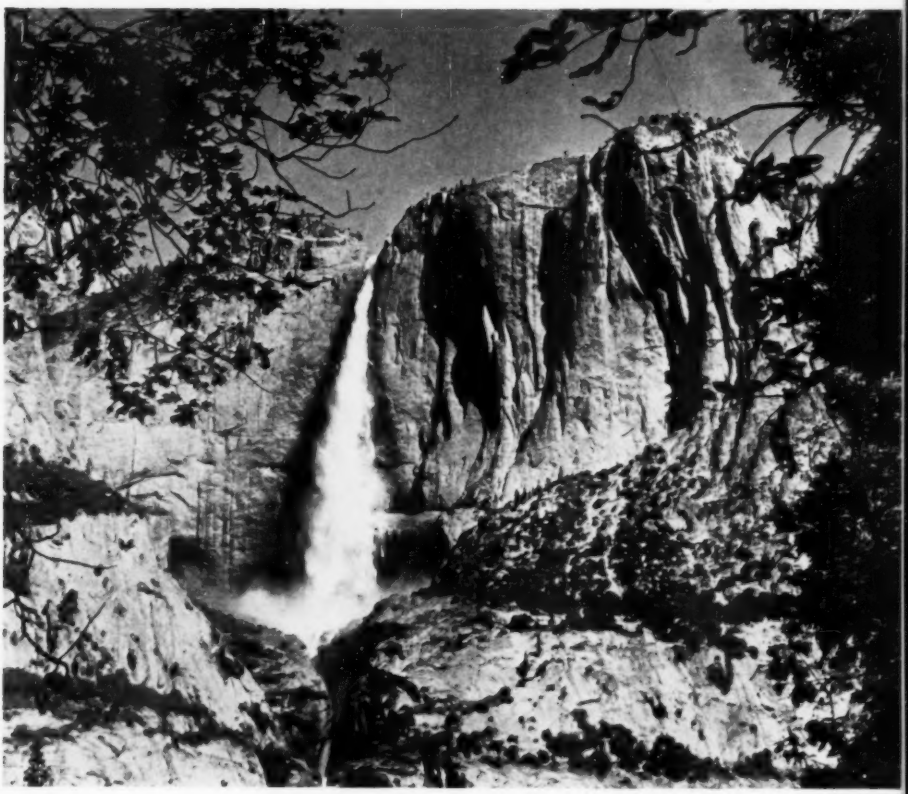
AMERICAN WATER WORKS ASSOCIATION



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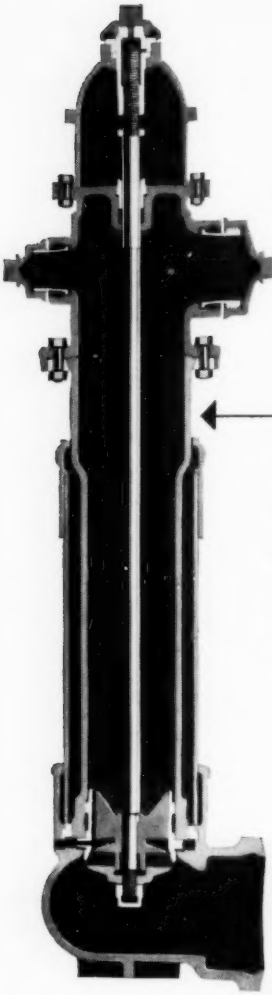

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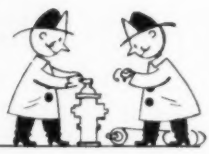

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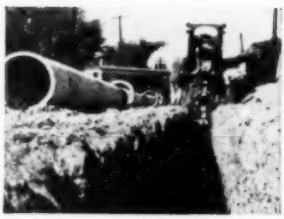

7. Maintenance: In thousands of communities, Transite Pipe—with its advantages of joints that remain tight and flexible, its corrosion resistance, and immunity to tuberculation—provides low-cost water transportation that requires little, if any, maintenance. Transite lines do not have to be cleaned, lined, or replaced because tuberculation has reduced their original capacity. Reports from communities all over the country prove that Transite's asbestos-cement structure provides economies that continue through the years.

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A.W.W.A. 1950 ANNUAL CONFERENCE

Philadelphia, Pa.

May 21–26

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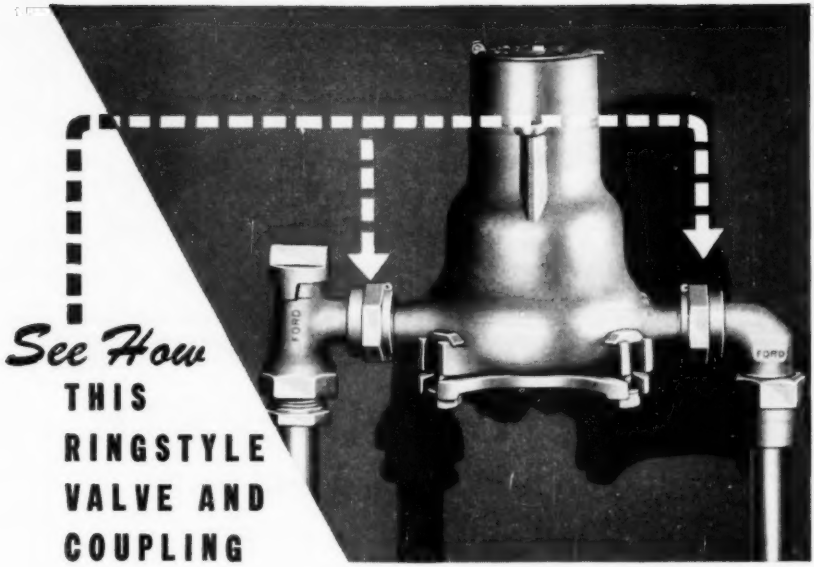
January 17, 1950—New York Section Midwinter Luncheon at Hotel Statler, New York, N.Y. Secretary: R. K. Blanchard, Room 1922, 50 W. 50th St., New York 20, N.Y.



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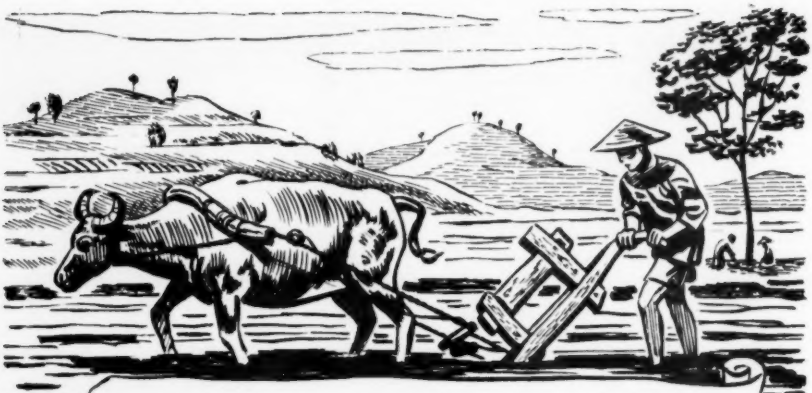

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Journal

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All correspondence relating to the publication of papers should be addressed to:

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Journal
AMERICAN WATER WORKS ASSOCIATION
VOL. 41 • DECEMBER 1949 • NO. 12

Radioactivity—A New Factor in Water Works Practice

By Arthur E. Gorman

A paper presented on Sept. 9, 1949, at the Minnesota Section Meeting, Minneapolis, Minn., by Arthur E. Gorman, San. Engr., Atomic Energy Commission, Washington, D.C.

MANAGEMENT and technical control personnel of public water systems, including public health officials concerned, are interested in new developments which may affect the quality of their product or their customary operating and control procedures. The principles of hydrology, chemistry, bacteriology, microbiology and epidemiology which pertain to water works practice are in general quite well understood. The techniques followed are standardized and their acceptance is founded on research and experience over the years which have stood the acid tests of evaluation and criticism by competent and conservative operators and technicians in many fields of science. Within the water works industry there has always existed an eagerness for refinements in methods and more economical operations, which is a healthy sign in any dynamic industry. There has been an awareness of the fact that the operation of a water system involves a public responsibility to keep abreast of all new developments which may in any way affect this service.

The purpose of this paper is to invite the attention of water works operators to certain aspects of radioactivity which may be of interest and concern to them as the increase in the use of radioactive materials in this country develops. The paper is presented in the belief that the new and rapidly growing atomic energy industry has ramifications of importance to the water works profession and that, conversely, workers in this profession have a responsibility and an opportunity to serve this industry.

Little need be said here about the destructive possibilities of nuclear forces, since they have had more than adequate publicity. As potential contaminating agents, radioactive materials

and waste products are properly items of concern to the water works and public health professions, and as such should be understood by them. It is, however, the possibility of using radioactivity as an effective tool in water works practice which offers the greatest challenge and opportunity. For this reason some of those working within the atomic energy industry who have an understanding of the problems of water system operators look forward to the day when knowledge of the properties and value of radioactive materials and the techniques of working with them is on as sound a professional basis within the water works industry as it is in the other related sciences previously mentioned. Much experience must be gained and much research carried out before full use of this new tool —radioactivity—can be attained. It should be recalled, however, that chlorine has been used effectively as a germicide during the past 40 years without too much knowledge of just how it kills bacteria; also, that there has been a great increase in the amounts of this chemical which could be used effectively with acceptance by the public health profession and the consumers. The use of radioactivity presents similar problems.

Types of Radioactivity

In considering radiation either as a health hazard or as a research tool, it is important to know its nature and some of its properties. All radioactive material is in a state of disintegration and gives off energy in the form of particles or rays. Some radioactive substances give up this energy and become inert in a few seconds or minutes. Others, such as uranium and plutonium, are long-lived. The former will emit one-half of its energy in—that is, has a half-life of—five billion years and the latter in 25,000 years. The inert end product will be lead.

The five classes (1) of radiation most frequently encountered in work of interest to the public health and water works professions are:

1. *Alpha particles*—large, highly damaging, positively charged particles. They are unable to penetrate the unbroken skin, but, if an element liberating them is deposited within the body, they may cause extreme damage.

2. *Beta particles*—moderately damaging, moderately penetrating, negatively charged particles. They will go through about $\frac{1}{4}$ in. of tissue.

3. *Gamma rays*—highly penetrating. They are less damaging, quantity for quantity, than the above types of radiation.

4. *Neutrons*—uncharged, high-speed, penetrating, highly damaging particles. Depending on their speed, they can penetrate several feet of tissue.

5. *X-rays*—similar to gamma rays, but less penetrating.

Extensive shielding is required in working with beta particles, neutrons and X- and gamma rays. The alpha rays, however, can be readily shielded by a piece of paper.

There is a very significant difference in the effect of the various types of radiation on human tissue. Externally the body has little protection against tissue damage by the ionizing radiation of X- and gamma rays, neutrons and beta particles. On the other hand, the alpha particles, and to a lesser extent the betas, are bone and tissue seekers. Therefore, they are particularly dangerous within the body, whether they enter by incision, ingestion or inhalation. For that reason, they are dangerous contaminants in water used for domestic purposes or in the air. Water works chemists are familiar with the takeup of iodine in

drinking water by the thyroid gland. Radioisotopes of iodine, if inhaled or ingested, will concentrate radioactivity in the tissue of this gland. Other radioisotopes are also selective.

Neutrons are capable of making salts dissolved in water radioactive. That is one of the reasons why water used as a coolant in a reactor must be given special treatment for purification and removal of elements having radioactive half-lives of significance in the ultimate disposal of this water.

Measurement of Radioactivity

Radioactivity may be measured quantitatively by instruments, such as Geiger-Muller counters and ionization chambers, that record the rate at which disintegration takes place. Qualitative measurements are made by radioautography, which is exposure on sensitized paper or film. There are as many varieties of equipment and methods as in the apparatus and techniques used in water analysis laboratories.

A water chemist, bacteriologist or sanitary engineer might well ask: "What is there about radiation which makes it more difficult to detect and interpret as to its public health significance than turbidity, total hardness, lead, nitrites, the hydrogen ion content or the 'most probable number' of coliform organisms? If a technician can learn to make such tests and interpret them in terms of water quality and safety, why can he not make radiological determinations?" The answer, of course, is that he can. But before he is capable of doing so he must receive training in nuclear physics, analytical techniques and interpretation of results. Similar training was a prerequisite to his becoming qualified as a water chemist, bacteriologist or sanitary engineer.

In chemistry, the competent water analyst must know, among other things, the properties of chemicals and the products of their reactions; in bacteriology, he must know the types and characteristics of bacteria, their food and living requirements, their metabolism and reproductive functions. So also, in dealing with radioactive materials, he must know the types of radiation they emit, their properties, their energies, their rates of decay and other significant characteristics.

Vocabulary of Radioactivity

In the various sciences, different units of measurement and a variety of descriptive terms and classifications of materials or matter are used to make working with the items less difficult. In the chemistry of water, such values as pH, alkalinity, color and hardness have real significance and acceptance; in the bacteriology of water, colonies per milliliter growing on agar at various temperatures, and gas formation in nutrient broths, are equally meaningful. In nuclear physics, the types of radiation and the rates of decay of various radioactive substances are highly significant.

The chemist finds it convenient to report the presence of elements or compounds in parts per million. The water bacteriologist uses the term "most probable number" in reporting coliform indexes. The radiologist and others in the field of nuclear physics use the convenient decimal systems for recording analytical values and expressing tolerances. For example 1.0 ppm. of any item is expressed as 1.0×10^{-6} units, 1.0×10^{-9} milliunits and so on. There is no difficulty in transposing such expressions of quantity, and they are cited merely to show the differences in custom and practice which must be faced when the water analyst works in the field of radiology. Such values as the curie (c.), the roentgen

(r.), the roentgen equivalent physical (rep.) and the roentgen equivalent man (rem.)—defined in the Appendix at the end of this paper—serve to give, in an elementary way, examples of expressions and nomenclature different from those to which the water analyst has been accustomed.

It will be seen, therefore, that the water works technician who wishes to be well informed on radiation hazards and to carry out the necessary control measures to protect people from radiocontamination must receive special training and must discipline himself in the practices and customs of another science so that he may be able to discharge this responsibility adequately. There is no short route to competency in the field of radiology and none should be sought.

Radiation as a Contaminant

Radiation as a contaminant of water supplies is less understood by water works and public health officials than chemical or bacterial contaminants. The hazards of radium contamination of water, especially in relation to the sale of water for medicinal purposes, were reported (2) in the JOURNAL in 1934. Information was also given concerning radium and radon in the water of certain oceans and a number of famous natural springs in Europe and the United States. The recent exploration for radioactive materials in the Colorado Plateau has created an increased interest in the radioactivity of waters in that area.

Supplementing earlier work on the radioactivity of natural waters, additional studies are in progress under Atomic Energy Commission (AEC) authorization, and findings will be published in due time.

Radioactive materials found in nature—such as uranium, thorium and their decay products—generally have a low level of radioactivity. Accordingly, they are much less hazardous as contaminants of water and air than are the high-level fission products and certain isotopes produced when prepared uranium and chemical compounds are subjected to bombardment by neutrons in man-made reactors like those operated by the AEC at Hanford, Wash., Oak Ridge, Tenn., Brookhaven, N.Y., or Los Alamos, N.M. These products are very expensive to make and their production and use are subject to rigid controls.

Extraordinary efforts are being made to prevent the exposure of workers or the loss of material or waste products resulting from recovery operations in amounts which would constitute a public health hazard. Even under these conditions, the contingency of an accident which might result in a spill of radioactive material is taken into consideration. Preventive measures against such a possibility are being carried out in the areas of operation, and such experienced federal agencies as the U.S. Geological Survey, the U.S. Weather Bureau and the U.S. Public Health Service, with whose activities most water works officials are familiar, are assisting the AEC in its preventive and control program.

State and local health and water works officials are showing increased interest in the problems of this new industry, and it is the policy of the commission to cooperate with them fully. Few public health and water laboratories are currently staffed with technicians or equipped with instruments and other facilities to make or interpret radiological analyses of water. This situation needs to be corrected, but it must be done on a well organized and controlled basis because in the field of radiation control a little knowledge

can be dangerous. At present a rather small but increasing group of radiologists and health physicists is carrying the burden of control and research in the atomic energy industry as related to public health and safety. This group realizes the need of transposing certain responsibilities in this field to qualified persons in various other professions and is working to that end.

Radiation Tolerance Level

About 30 years ago it was observed that a number of prominent radiation workers in the United States and Europe had died apparently of a form of anemia resulting from radiation exposures. Since then much has been done internationally to establish a basis for tolerances to radiation which would protect such workers. The tragic story of the workers in the luminous-paint industry, who in the 1920's tipped watch hands and other instruments with radium compounds, is well known. Studies of the exposure and symptoms of these unfortunate people added greatly to the knowledge of the effects of radiation on humans. To a considerable extent, these studies form the basis for the so-called tolerance limits of exposure now applied.

TABLE 1

Maximum Permissible Concentrations of Radioactive Contaminants

Locale of Exposure	Max. Concentration *microcuries/ml.*	
	Beta or Gamma Emitter	Alpha Emitter
Air	10^{-9}	5×10^{-12}
Water	10^{-7}	10^{-7}

The commission, whenever possible, has adopted the standards established by the National Committee on Radiation Protection (1), which includes representatives from the National Bureau of Standards, the U. S. Public Health Service, the Atomic Energy Commission and professional groups of radiologists and X-ray workers. Among the eight subcommittees working on various standards are three of special interest to water works and public health officials; these are the subcommittees on: "Handling of Radioactive Isotopes and Fission Products"; "Monitoring Methods and Instruments"; and "Waste Disposal and Decontamination."

It is expected that in the near future tentative recommendations on the maximum permissible limits of radioactivity in water and air will be made by the national committee. In a paper presented before a seminar on waste disposal in January 1949, K. Z. Morgan (4), Director of the Health Physics Div., Oak Ridge National Laboratory, suggested the maximum concentrations given in Table 1 for general radioactive contaminants beyond the areas of AEC control. Table 2 shows some of the radioactive fission products and the calculated tolerance concentrations in water given by Morgan.

Concern of Water Officials

The AEC understands the interests and concern of water works and public health officials in the problem of radioactive contamination of sources of water supply, remote as this contingency may be. For that reason, a seminar (5) on disposal of radioactive wastes was sponsored by the AEC in Washington in January 1949, to which representatives of the above and other professions were invited. During this seminar the operations and processes which involve radioactive materials were described, the various types of wastes resulting were discussed and

their public health values were appraised. It is through meetings of this kind that the representatives of the water works and atomic energy industries can obtain a better understanding of their joint problems and interests.

Should there be a spill of radioactive material, monitoring facilities of the AEC and its contractors would be available to advise the water works and public health officials concerned. The desire of certain water works officials to purchase radio detection instruments with which to carry out their own investigations is understandable. The time will and should come when water works and public health officials can make radiological analyses of their water supplies both at the sources and during various stages of treatment.

TABLE 2

Tolerance Values for Radioactive Fission Products

Element	Mass No.	Per Cent Absorption in Critical Tissue	Critical Tissue	Tolerance—*microcuries/l.*	
				Ingestion	Submersion
Strontium	89	15	bone	2.4	3.2
Columbium	95	0.2	bone	236	2.0
Iodine	131	20	thyroid	0.02	2.83
Cesium	137	30	muscle	5.2	1.7

Research and Analysis

Much more research training and developmental work need to be carried out in the field of sanitary engineering. Some research to determine the effect of water treatment methods in removing radioactive contamination from water and the effect of radioactivity on processes of sewage treatment is being done at several major AEC areas and through contracts with the sanitary engineering divisions of Johns Hopkins and New York Universities and the Massachusetts Institute of Technology. The military and civilian defense aspects of such research are being given careful consideration.

The possibilities of using radio isotopes as tracers in research work in the water works industry are many. Among them may be mentioned well logging, studying the flow of water in pipes and underground, and investigations of the causes of corrosion and phenomena associated with adsorption, absorption, settling, flocculation, filtration and ion exchangers.

The analysis of water for radioactivity is not a simple process—indeed, it is a complicated and expensive procedure, involving the use of special equipment and instruments (6) and the ability to recognize the existence and significance of various types of radiation. The results obtained must be adjusted for geometric factors inherent in the instruments used, and the range of possible errors must be evaluated. Any water works official who is planning a new laboratory unit or building for radiological work would do well to obtain advice from experienced operators of radiological laboratories on the layout and design of this facility and its equipment and control features.

In laboratories working with radioactive materials special precautionary measures must be taken. Work of this kind cannot be done safely in an ordinary laboratory. The space used must be separated from other work areas

and must be well ventilated; radioactive materials must be stored in special shielding containers; glassware and utensils must be kept separate and be cleaned and decontaminated using special agents and careful procedures; every reasonable precaution must be taken against the contingency of a spill; sinks and workbench tops and floors should be of materials which can be readily decontaminated. Waste solutions and contaminated glassware and utensils must be stored to permit the decay of radioactivity to tolerance levels before being released, or they must be otherwise effectively treated. Working areas and plumbing fixtures must be monitored regularly for radioactivity to prevent overexposure, and workers may be required to wear special protective clothing. Gaseous wastes, mists or fumes from hoods must be given special treatment for decontamination before being released to the atmosphere.

The above listing of precautionary measures is not made with the idea of discouraging any water works official or research worker from taking a keen interest in the analytical and control aspects of radioactivity in relation to his responsibilities as a utility operator, but rather to indicate some of the important considerations which must be taken into account if his efforts are to be productive of accurate results with safety to the workers involved.

It is to be expected that some of the time-consuming and tedious techniques now used in the radio-assaying of water will be simplified and that instruments will be developed which will make it possible to obtain quick and accurate field and laboratory results. Indeed, development work along these lines is being actively carried out at most AEC areas. The water chemist and bacteriologist have in the past contributed much to the development of simplified and more accurate methods, techniques and instrumentation, and, as their experience and knowledge of radiometric practices grows, it is to be expected that they will render similar services to their professions in this field.

Conclusions

1. Water works and public health officials are naturally concerned with all possible contaminants of water supply and have an understandable interest in the radioactive products and wastes of the new atomic energy industry.

2. Radioactivity has possibilities of becoming a valuable research tool in the water works industry, as it is in other industries.

3. Water works personnel must receive training in nuclear physics and in methods and instruments used to detect the radioactive contamination of water, as well as in interpreting the results obtained.

4. Within the atomic energy industry, rigid controls are in effect to prevent the exposure of personnel to hazards of radiation and to prevent the loss of radioactive products which could affect the safety of water supplies.

5. Much research is in progress, under AEC sponsorship, to develop and improve methods and instruments for detecting radiation in water and air.

6. In the near future the National Committee on Radiation Protection, which includes representatives of various government agencies, professional groups and research institutions, will announce its recommendations on the maximum safe limits of radioactivity in water and air as a guide to all interested parties.

7. The extent and nature of the facilities required, as well as the control procedures necessary for laboratory research on radioactive materials,

render it essential for safety that special provision be made in planning, staffing and operating such a laboratory.

8. It is to be hoped that water works technicians in increasing numbers will, through training and education, become qualified to carry out their responsibilities to their profession in matters pertaining to radiation as they now do in the fields of public health, chemistry and hydrology.

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APPENDIX

Definition of Terms Relating to Radioactivity

Atom—the smallest unit of which a chemical element is built. The simplest atoms are those of hydrogen; the most complex, those of uranium (9).

Chain reaction—a term applied to any chemical or nuclear transmutation process in which some of the products of a particular change assist the further development of that change (9).

Curie—a measurement of the number of atoms or molecules in a mass of material which disintegrates in a specified time period. A curie source of radioactive material is a source that disintegrates at the rate of 37,000,000,000 (3.7×10^{10}) atoms per second (2). A *microcurie* is one-millionth of a curie.

Ionization—the process by which an atom which is ordinarily electrically neutral acquires an electrical charge. An atom thus ionized is called an ion (9).

Isotope—any of two or more forms of a chemical element which have the same chemical properties but differ in atomic weight.

Roentgen (*r*)—a unit describing the amount of radiation energy which is stopped (or partially stopped) by material in its path, thereby producing ionization, the source of damage to human tissue. The roentgen is a quantity of "X" or "gamma" radiation which produces a specified amount of ionization in air (2).

Roentgen equivalent physical (*rep*)—a quantity of radiation which produces a specified amount of ionization in tissue (2).

Roentgen equivalent man (*rem*)—that quantity of radiation which, when absorbed by man, produces an effect equivalent to the absorption by man of one roentgen of "X" or "gamma" radiation.

The Status of Fluoridation in 1949

By Harry A. Faber

A revised version of a paper originally presented on Sept. 15, 1949, at the Pennsylvania Section Meeting, Harrisburg, Pa., by Harry A. Faber, Research Chemist, The Chlorine Institute, New York.

THE practice of fluoridation is unique among methods for the treatment of public water supplies because it is an additive rather than a subtractive method. All other methods of water treatment, applied for the protection of public health, have been devised to reduce excessive concentrations of constituents present in natural waters. Fluoridation is employed to increase inadequate concentrations of a constituent present in natural waters. There is little difference in principle between fluoridation and other methods of treatment, but there is a considerable difference in philosophy.

In its general attitude toward this unique method of water treatment, the water works industry will do well to recognize, as did Wolman in his foreword to *The Quest for Pure Water* (1), that: "Neither the consumer nor the professional should be disconcerted by this endless adventure in search of 'pure' water. It is the natural concomitant of advancing knowledge and expanding horizon." The specific attitude of the water works industry, however, will be determined by factual information regarding the present status of water fluoridation. It is the purpose of this paper to present such information in summary form.

Background

The basic evidence, demonstrated by carefully conducted statistical studies, indicates that, in communal water supplies, minimum concentrations of naturally occurring fluoride ion are desirable and excessive concentrations are detrimental. The range between the limiting concentrations is very narrow.

The importance of the fluoride ion in drinking water was discovered less than twenty years ago, and it was soon recognized that excessive concentrations of this ion were the cause of fluorosis or mottled tooth enamel. Subsequent investigations have established 1.5 ppm. fluoride as the maximum concentration which does not produce fluorosis. With higher concentrations, mottled tooth enamel becomes increasingly more severe; at 6.0 ppm. almost every child will be affected.

Much study has been given to the development of methods for the treatment of water to remove the fluoride ion. Fluoride removal methods so far developed are extremely costly to install and operate. More than 350 public water supplies in the United States are reported to contain excessive concentrations of fluoride ion, and fluoride removal treatment is provided in only ten of these.

In 1938 studies by Dean disclosed the existence of an inverse ratio between dental caries (tooth decay) in children and the fluoride content of the communal water supply. His results showed dental caries experience to be

at a minimum when the water contained 1–1.5 ppm. fluoride. This concentration of fluoride ion was found, by examination of over 7,000 school children, to be associated with a 50–65 per cent reduction in caries prevalence. The relation is illustrated in Fig. 1.

Evidence of the relation between dental caries and the fluoride content of water supplies has been largely based upon studies of children. There have been few data concerning the dental health of adults who were exposed to fluoride-containing water during childhood. The results of a study by McKay provide some evidence that the inhibitory effect of fluoride, once acquired, may be permanent. His study was based on the examination of 400 adults who were natives of Colorado Springs, Colo., where the water supply has a natural fluoride content of 2.6 ppm. and has been in use for about 70 years. Although these adults were found to have mild dental fluorosis, they exhibited an unusually low rate of permanent-tooth loss. A comparison of the findings with the normal expectancy of tooth loss for the United States is illustrated in Fig. 2.

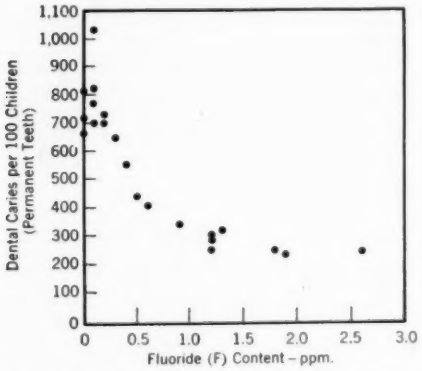

FIG. 1. Relation of Caries to Fluoride Content of Water Supply *

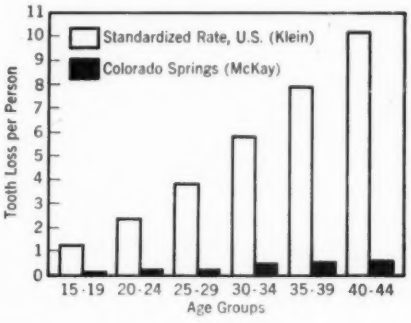

FIG. 2. Tooth Loss at Colorado Springs Compared With "Standardized Rate" *

* Taken from "Fluorine in Dental Caries Control" by H. T. Dean; *Postgrad. Medicine*, 5:361 (May 1949).

Theory of Fluoridation

An inverse relationship appears to exist between the fluoride content of natural waters and the prevalence of dental caries. Recognition of this relationship led to the proposal that fluoride be added, as a caries control measure, to waters deficient in that constituent.

The control of caries by adding fluoride to a public water supply is based on the hypothesis that the water so treated will have the same effect as one naturally containing fluoride. This hypothesis appears justified by chemical and biological considerations, by laboratory research and by statistical evidence.

At least eight years will be required before a preliminary indication of the full effect of fluoridated water on dental caries can be determined—that is, until children have used fluoridated water throughout the period of tooth enamel formation (through age eight for all teeth except the third permanent molars).

The validity of the hypothesis can be tested only by carefully controlled experimental studies. Several studies of this nature are now under way, gen-

erally planned on an eight- to ten-year basis and directed by specialized technical personnel. The application of fluoride is made under the supervision of the state department of health. Dental and medical studies are made of children in the community, and another community having a similar water supply low in fluoride content is studied as a control.

In the United States, the first experimental studies of water fluoridation were inaugurated in 1945; in January at Grand Rapids, Mich., and in May at Newburgh, N.Y. Both cities employ sodium fluoride as the source of the fluoride ion.

Official Attitudes

Up to 1949 the attitude of the water works industry toward fluoridation treatment was generally in accordance with the summary (2) presented by Wolman in 1943, and by his four guiding principles (3) suggested in 1947. Briefly, this attitude approved the carefully controlled experimental studies but recommended the avoidance of more general adoption of fluoridation until the completion of those studies.

The A.W.W.A., in 1949, gave official acceptance to the practice of water fluoridation for the purpose of reducing tooth decay. A statement of recommended policy and procedure, approved by the Board of Directors of the Association (4), said, in part:

> In communities where a strong public demand has developed and the procedure has the full approval of the local medical and dental societies, the local and state health authorities, and others responsible for the communal health, the water departments or companies may properly participate in a program of fluoridation of the public water supplies.

The official sanction by the A.W.W.A. of the practice of water fluoridation may be expected to have considerable influence on the future development of this practice. Accordingly, the appraisal of certain items in the statement of recommended policy and procedure is warranted.

1. The water works profession has been given a clearly defined position in the practice of water fluoridation. Water utilities may properly undertake fluoridation when public demand and health authority approval precede adoption of the treatment. The cost of fluoridation may properly be charged against community health expenditures.

2. In the adoption and operation of fluoridation, uniform procedures have now been recommended. These include specific information regarding handling fluoridation requests, responsibility for fluoridation, liability involved, steps in authorization, disposition of cost, items of cost and application and control of treatment.

3. Additional experimental studies of fluoridation are recommended, especially to determine the effect of climatological conditions on this practice.

4. Finally, and perhaps most important, empirical installations for fluoridation may now be approved.

The A.W.W.A. statement explains, but does not define, the terms "experimental" and "empirical." In the practice of this treatment, the following definitions would appear to be suitable:

Experimental installations—those in which fluoride is applied to water under controlled conditions, with the concurrent use of scientific methods to test the fluoride-caries relationship.

Empirical installations—those in which fluoride is applied to water under controlled conditions, without the concurrent use of scientific methods to test the fluoride-caries relationship.

Results of Fluoridation Survey

Ultimate jurisdiction over the treatment of a public water supply is vested in the state health authority. It is clear that a program of water fluoridation can properly be undertaken only with the approval of that authority. Accordingly, the general attitude of the state on water fluoridation will have an important influence on the future development of this practice.

A survey has been made by the author to determine the water fluoridation policy of the various state health authorities. A questionnaire was sent to the chief sanitary engineer of each state, and replies were received from all 48 states. The cooperation of these individuals has made it possible to present a comprehensive summary of the status of water fluoridation as of August 1949.

TABLE 1

Fluoridation Installations—Public Supplies

State	Experimental	Empirical	Total
Idaho	1		1
Illinois	1		1
Kansas	1		1
Michigan	1	1	2
New Jersey	1		1
New York	1		1
North Carolina	1		1
Texas	1		1
Wisconsin	3	5	8
Total	11	6	17

Approximately 40 per cent of the states have adopted a definite policy regarding the fluoridation of public water supplies, and 70 per cent of the states consider the A.W.W.A. statement of policy acceptable. All of the states which may give approval to experimental installations, however, are not willing to approve empirical installations. Replies from the 48 states show that: 19 have adopted a policy regarding fluoridation; 33 consider the A.W.W.A. statement of policy acceptable; 34 may give approval to experimental installations; and 27 may give approval to empirical installations.

Only one-third of the states have adopted a definite procedure regarding the fluoridation of public water supplies, but 70 per cent of the states consider the A.W.W.A. "Tentative Recommended Procedure" acceptable. A maximum fluoride ion concentration of 1.5 ppm. would be permitted by 22 states. Replies from the 48 states show that: 16 states have adopted a procedure regarding fluoridation; 33 states consider the A.W.W.A. "Tentative Recommended Procedure" acceptable; 7 would permit a maximum of 1.0 ppm. fluoride (F); 1 state, 1.1 ppm.; 3 states, 1.2 ppm.; and 22 states, 1.5 ppm.

TABLE 2

Future Installations—Public Supplies

State	Already Approved	Under Consideration
Arkansas	1	
Colorado	2	
Connecticut		3
Delaware		1
Florida	1	1
Kansas		1
Michigan	3	
New Jersey	1	
New York	1	3
North Dakota		2
South Carolina		1
South Dakota		1
Texas	1	1
Virginia		1
Wisconsin	4	4
Wyoming		1
Total	14	20

A total of 17 fluoridation installations are in operation in the public water supplies of 9 states; each of 7

states has 1 installation, 1 state has 2 installations and 1 state has 8 installations. Of the 17 installations, 11 are classified as experimental and 6 as empirical. The location of these installations is shown in Table 1.

Three fluoridation installations—all experimental—are in operation in institutional water supplies in two states, two in Massachusetts and one in Connecticut.

The growth of public water supply fluoridation is indicated by installations which have already been approved by state health authorities or which are now under consideration by them. A total of 14 fluoridation installations are reported to be already approved, and 20 are under consideration. The location of these installations is shown in Table 2.

Effect of Fluoridation

It is considered that positive evidence of the effect of fluoridation in reducing dental caries has not been produced in the 4½ years of experience at Grand Rapids, Mich. In a letter to the author, in September 1949, Fred Wertheimer, Chief, Public Health Dentistry Section, State Dept. of Health, stated: "I do not see how we can obtain any tangible evidence from Grand Rapids for another three or four years. The children must use the treated water during the period of permanent tooth formation, which is from birth through eight years of age, and these teeth must then be erupted into the mouth where they can be examined. Only then can any definite conclusions be drawn."

Dental findings in the Newburgh-Kingston, N.Y., project have recently been reported by David B. Ast (5), Chief, Dental Health Section, State Dept. of Health. The data relate to comparative trends in DMF (decayed, missing, filled) teeth of children in the group six to twelve years of age. Examinations included 3,400 children in Newburgh, all assumed to have been continuously exposed to fluoridated water for a period of three years, and 2,800 children in Kingston, where the water is not fluoridated.

The DMF experience rate in Newburgh averages 30 per cent lower than in Kingston, among children of this age group. Rates of DMF experience were found to be similar in the two cities during the first year since fluoridation, but to be consistently lower thereafter in Newburgh than in Kingston. The major benefit of fluoridation is shown by those teeth generally less subject to caries attack; the permanent molars show an 18 per cent lower DMF experience rate, and the incisor teeth a 55 per cent lower rate, in Newburgh than in Kingston. Another five years will be required to present a final report.

Pediatric findings in the same project were reported (6) to show no deleterious effect of fluoride intake. The same pediatric team has continuously studied 500 children in Newburgh and an equal number in Kingston. Physical examinations, laboratory tests, bone X-ray studies and special examinations have revealed no detectable differences between the two groups of children.

F. A. Bull, Director, Div. of Dental Education, Wisconsin State Board of Health, has reported (7) on the third post-fluoridation survey at Sheboygan, Wis., where fluoridation was started in February 1946. His survey shows that, in less than three years, the DMF rate for kindergarten children (five to six years) has been reduced 28 per cent. The DMF rate for fourth-grade children (nine to ten years) has been reduced 19 per cent. In the opinion of the Wisconsin State Board of Health, the evidence presented demonstrates

that artificial fluoridation of a public water supply has reduced caries about 20 per cent.

Special comment should be made concerning the growth of water fluoridation in Wisconsin, where three municipal supplies are now treated on an experimental basis and five on an empirical basis. As of August 1949 approval had been given by the state department of health to four more installations, and four others have been submitted to the department for consideration. The state supervisor of dental education reported that, in addition to the above, ordinances for the fluoridation of water have been approved by 33 municipalities and have been introduced, but not yet voted upon, by sixteen others.

As early as 1945 the Wisconsin State Dental Society adopted a recommendation approving fluoridation of water supplies deficient in fluorides, providing that the application be under the supervision of dental, medical, engineering and public health personnel. After considerable study, this action was approved by the state board of health in 1946. The policy of the board was modified in 1949 so as to accept empirical installations of fluoridation. The Wisconsin State Dental Society has a very active committee on the fluoridation of water, which gives much time and effort to educational discussions before civic groups. This committee has been largely responsible for local demands that the public water supply be fluoridated. The favorable attitude of state health officials has, of course, been essential.

Fluoridation Chemicals

The fluoridation of nearly all water supplies is accomplished by the carefully regulated application of sodium fluoride. The commercial salt, having a sodium fluoride content of 90 per cent, is generally employed. The composition of this salt is such that 20.4 lb. are required per million gallons of water to obtain a 1.0-ppm. concentration of fluoride ion. Since many natural waters contain some fluoride ion, the amount applied must represent the difference between the concentration originally present and the concentration desired in the finished water.

One municipality employs 60 per cent hydrofluoric acid as the source of fluoride ion. The distribution system is supplied from several unit wells at each of which chlorination and fluoridation is provided. The hydrofluoric acid is applied from storage tanks by means of special chemical feed pumps.

Consideration has recently been given to the use of sodium silicofluoride instead of sodium fluoride to supply the fluoride ion. The silicofluoride (Na_2SiF_6) contains 60 per cent fluoride ion, while the fluoride (NaF) contains 45 per cent. The prices of these compounds are such that sodium silicofluoride will supply fluoride ion at about one-fourth the cost of obtaining it from sodium fluoride. Sodium silicofluoride is a by-product of the manufacture of phosphates from certain phosphate rocks. Its solubility is low (4.7 g. per liter at 2°C.) and may be a disadvantage in this application but should present no difficulty where the material is applied through dry-feed equipment provided with adequate dissolving facilities. The low solubility may create a storage and feeding problem where solution feeders are employed. Studies of the suitability of this compound should include determination of its toxicity by means of animal-feeding experiments.

Milwaukee was first reported to be considering the use of sodium silicofluoride as a substitute for sodium fluo-

ride. It was estimated that water fluoridation would cost about 2.75¢ per capita per year with the silicofluoride, as against 14¢ with the fluoride salt. The first plant scale study of sodium silicofluoride appears to be the one at the Sheboygan, Wis., plant in October 1949, when the feeding of 1,000 lb. was reported to have been undertaken on an experimental basis.

Rhinelander, Wis., is proposing the use of hydrofluosilicic acid, to be applied by means of chemical feed pumps.

Fluoridation Equipment

Sodium fluoride, or any fluoride salt, must be applied by means of accurate feeding equipment. Either gravimetric or volumetric dry-feed equipment, or positive-displacement liquid-feed equipment, with an accuracy within 5 per cent is required. The most suitable type of equipment will probably be determined by the weight of chemical to be applied per hour or per day.

Special precautions must be taken to protect the operators from inhaling fluoride dust when charging the hoppers of dry-feed equipment. It is recommended that the hoppers be equipped with dust collectors which include bag filters, operate under positive air pressure and are vented to the atmosphere outside the plant. Each operator who handles fluoride should be provided with an individual toxic-dust respirator and should use it only when handling that chemical. When liquid-feed equipment is used, at least two solution tanks must be available for the preparation and storage of the fluoride solution.

Equipment suitable for feeding sodium fluoride may be obtained from the following manufacturers, and perhaps others:

1. Gravimetric loss-in-weight and volumetric types of feeders with dust collecting equipment—Omega Machine Co., Providence, R.I.; Wallace & Tiernan Co., Inc., Newark, N.J.

2. Volumetric types of feeders with dust collecting equipment—Infilco, Inc., Chicago.

3. Positive-displacement types of liquid feeders (diaphragm types)—Proportioneers, Inc., Providence, R.I.; Wallace & Tiernan Co., Inc., Newark, N.J.

4. Positive-displacement types of liquid feeders (plunger types)—Proportioneers, Inc., Providence, R.I.

5. Other types of liquid feeders: decanting type—Liquid Conditioning Corp., Philadelphia; constant-head orifice type—Infilco, Inc., Chicago; wet-chemical type—The Permutit Co., New York City.

6. Equipment suitable for feeding 60 per cent hydrofluoric acid may be obtained from the following manufacturer, and perhaps others: fluid plunger types of chemical feed pumps—Proportioneers, Inc., Providence, R.I.

Financing Fluoridation

It is obvious that the fluoridation of a water supply will increase the utility's operating expense and investment cost. The total cost is estimated (4) to range from 5¢ to 15¢ per capita per year, depending upon the amount of fluoride in the supply before fluoridation, the size of the community and the per capita use of water. The cost of fluoridation may be considered a proper charge against communal health activities, since the benefits to be derived by the consumer bear no relation to the amount of water used. This method of financing is probably the most widely employed to date. The laws of Wisconsin relating to water charges (Chap. 325 and 328, Laws of 1949) were, however, amended during 1949 to read:

The council or board of any town, village or city operating a public utility may, by ordinance, fix the initial rates and provide for this collection monthly, quarterly or semiannually in advance or otherwise. The rates shall be uniform for like service in all parts of the municipality *and shall include the cost of fluorinating the water.* The charges shall be collected by the treasurer.

In the case of a public water utility, the commission shall include, in the determination of water rates, the cost of fluorinating the water in the area served by such public water utility, provided the local governing legislative body in which such public water utility is situated authorizes the fluorination of water in the area primarily served by such public water utility.

Needed Research

Further experimental studies are necessary to determine the effect of climate and geographical location as factors in water fluoridation. The A.W.W.A. statement of policy discusses evidence that a constant and uniform fluoride content of 1.0 ppm. may be inadequate —where water consumption is low— and fail to exert the maximum protective effect; or may be excessive—where water consumption is high—and result in the formation of mottled enamel. A recent report (8) indicates that, in one community in New Mexico, fluorosis may result from the presence of as little as 0.7 ppm. in the water supply. It has been suggested (9) that the technique of fluoridation be refined on a seasonal basis for each installation; by this method, the fluoride concentration would be varied in relation to the temperature of the locality (and hence the water intake) so as to provide the maximum protection from caries and the minimum development of mottled enamel.

It is reported that free available residual chlorine interferes with the test for fluoride as given in the latest edition of *Standard Methods for the Examination of Water and Sewage,* and a satisfactory method for the elimination of errors due to such interference must be developed.

The fluoridation of one water supply appeared to result in a serious increase of cracking in ice manufactured from the water (*see* p. 1069). This problem has not been reported in any other municipality practicing fluoridation and may be due to the exceptionally low dissolved-solids content (45 ppm.) of the particular water supply involved.

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Effect of Fluoridated Water in Ice Manufacturing

By Zachary M. Stadt and Robert S. Phillips

A contribution to the Journal by Zachary M. Stadt, Director, Div. of Preventive Dentistry, Health Dept., Charlotte, N.C., and Robert S. Phillips, Supt. of Plants & Chief San. Engr., Water Dept., Charlotte, N.C.

THE application of sodium fluoride as a dental health experimental project at Charlotte, N.C., was begun on April 25, 1949. The project is directed by the Charlotte Health Dept. as authorized by the city council. Since Charlotte water contains only 0.05–0.10 ppm. natural fluoride, the dosage prescribed was 1.05 ppm. fluoride (F). This level was maintained until May 21, 1949, when the application of sodium fluoride to the water supply was suspended temporarily by order of M. B. Bethel, Charlotte health officer.

Approximately a week after the beginning of fluoridation the local ice manufacturers reported a severe increase in brittle and cracked ice. Estimates by the industry of total production cracked varied between 30 and 75 per cent. One plant, however, informed the water department that it had been able to reduce the amount of cracked ice to approximately 5 per cent by raising brine temperatures to 16–18°F. This procedure was not practical for other operators because maximum plant production during the summer season required lower brine temperatures. Since cracked ice is hazardous to handle, unattractive in appearance, not easily scored and in relatively little demand, the problem soon developed serious proportions. As a result, the health department temporarily granted the request to suspend fluoridation of the water supply in order to provide time in which to determine the cause and to seek a remedy.

Prompt inquiries made to other municipalities and agencies practicing fluoridation brought forth entirely negative replies; no other municipality is experiencing ice cracking due to fluoridation. It is difficult, however, to make comparisons with these cities because Charlotte water apparently contains less mineral matter in solution (approximately 45 ppm.) than any other supply being fluoridated. As a matter of fact, the water in Charlotte has such a small amount of dissolved matter that ice manufacturers found it easy to produce a high-grade ice even without core removal.

After fluoridation had been stopped, the ice industry reported that cracking and brittleness were reduced to "normal." The water department immediately began experimental work on the problem at two of the commercial ice plants, with the wholehearted cooperation of the Charlotte ice industry. The investigative work proceeded to make rapid headway and is still continuing. In order to evaluate the findings properly, ice made from nonfluoridated water was compared with ice from water containing known fluoride concentrations. Chemically pure sodium fluoride was used.

Repeated experiments have clearly demonstrated that the addition of 1.0–1.5 ppm. fluoride (F) to the Charlotte water will result in a tremendous increase in the cracking of manufactured

ice. Of 121 300-lb. blocks manufactured from fluoridated water with the above dosages, 73 were cracked, while only 2 of 139 observed controls showed flaws under identical conditions.

Coincident with some of the above studies, additional work was undertaken to determine the effects of the so-called ice-tempering, or anticrack, compounds used by the ice industry in places where cracking is encountered from other causes (1, 2). These compounds are available commercially under various trade names. On an experimental scale, it has been possible to show a remarkable reduction (to below 10 per cent) in the percentage of ice cracking by adding these compounds to fluoridated water.

During one of the studies the American Cyanamid Co. set up a water-demineralizing unit for demonstration purposes. To a small tank of non-fluoridated Charlotte water 1.5 ppm. sodium fluoride (F) was added. Enough demineralized water was prepared from this source to freeze eleven blocks of ice. Although cores were not "pulled" (that is, the core solutions were not removed), the resultant ice was completely free of flaws.

It has long been recognized that the mineral salts in water solution tend to migrate to the core during the freezing; with aeration of the water, this tendency is increased (3, 4). This statement holds true for the fluoride ion. With water containing 1.0–1.5 ppm. fluoride (F), concentrations as high as 15 ppm. (F) have been found in the core solution at the time when it would normally be removed (24–26 hours after the beginning of the freeze). If the core solution is not removed and replaced with fresh water, the solid-frozen core may contain as much as 25–30 ppm. fluoride (F) at Charlotte when the water is fluoridated.

Although all of the data collected to date clearly point in the direction outlined above, the authors wish to emphasize several items at this time:

1. Certain of the findings must be regarded as tentative. Some phases of the work are still under investigation and will be reported in detail when the studies have been completed.

2. These experiences have not been reported elsewhere and therefore must be presumed to be applicable solely to Charlotte water until such time as other water supplies of the same character are fluoridated.

3. The data on the effects of anticrack compounds are purely experimental and on a relatively small scale. Confirmation of the preceding conclusions on a commercial scale is now being sought by the resumption of fluoridation.

Acknowledgment

The authors wish to acknowledge the generous assistance furnished them by T. A. Childs and H. V. Sisk, representing the local ice industry; by the personnel of the Electric Ice and Fuel Co. and the Westside Ice Co. where the experimental work was conducted; and by J. Giles Foushee and Angus Benton, sanitary engineer and chemist, respectively, who assisted in some of the work and made some of the analyses.

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The Installation of Cast-Iron Water Mains

By Joseph P. Schwada

A paper presented on Oct. 11, 1949, at the Wisconsin Section Meeting, Milwaukee, Wis., by Joseph P. Schwada, City Engr., Milwaukee, Wis.

THIS paper will discuss some of the major items in the A.W.W.A. "Tentative Standard Specifications for Installation of Cast-Iron Water Mains —7D.1–T," the text of which appears in this issue of the JOURNAL (p. 1079).

Responsibility of Engineer

In the preparation of contract documents for any project, the engineer should recognize that he has certain responsibilities which, in fairness to the owner and the contractor, he should assume. The engineer should definitely set forth all the requirements of the contract and include a detailed description of the work to be done, the materials to be used and the methods of construction. In addition, he should show on the drawings all factors influencing the prosecution of the work, so that the bidders can submit reasonable proposals and the successful bidder can do the work according to a plan. Failure to do so will invariably increase the cost and may produce many disturbing differences of opinion between the engineer and the contractor during the course of the work.

An item of particular importance in considering the responsibilities of the engineer is underground structures, including the rearrangement of sewers, conduits, pipes or other facilities. The engineer should make a thorough investigation of all available records and show on the drawings the locations and character of all structures that are to be altered or rearranged and also those that will influence the work of the contractor. This practice will eliminate the necessity for including allowances for contingencies in the bids and extras on the work. The engineer should also make an investigation of the rights and responsibilities of all parties involved so that when the drawings are prepared, the work to be done can properly be allocated between the owners of the structures and the contractor. When structures not previously known and not shown on the drawings are encountered during the progress of the work, the rights and responsibilities of the parties involved will also determine the allocation of the additional work and its cost, as well as the extra compensation to the contractor.

Materials Furnished

If the owner is to furnish any materials, the engineer should so specify and include a description of the materials and their approximate weights. The engineer should also specify what materials furnished by the owner are to be hauled from the yard of the owner or unloaded from railroad cars and hauled to the site by the contractor.

If the contractor is to furnish any materials, a detailed description of them should be included in the specifications

so that fair competition may be obtained and satisfactory materials installed. The selection of materials should not be left to the contractor.

Excavation and Preparation of Trench

Another item of importance is the excavation and the preparation of the trench. This subject is covered in the A.W.W.A. specifications by the inclusion of alternate procedures for the preparation of the trench bottom, depending upon the nature of the soil at subgrade.

Obviously, when the engineer specifies a certain procedure for the preparation of the trench bottom in a particular locality, he should have a knowledge of the soil conditions. Even then, provisions should be included for changing from one procedure to another if the conditions encountered at subgrade make it advisable.

Where the soil at subgrade is uniformly good, and stones, hardpan, shale or cemented gravel is not exposed, it is good practice to excavate to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid, undisturbed ground.

Where the soil at subgrade is not uniformly good, it is advisable to excavate to at least 3 and not more than 6 in. below the specified grade. Before the pipe is laid, the subgrade should be prepared by backfilling to grade with an approved material, which should be tamped to provide a uniform and continuous bearing and support for the pipe. Mechanical tampers are available for this work.

The contract specifications should also include provisions for additional excavation and backfilling where the soil encountered at subgrade is unstable or includes ashes, cinders, refuse, vegetable or other organic material, or large pieces or fragments of inorganic material, which, in the judgment of the engineer, should be removed and replaced with an approved material compacted in place.

Where the material at subgrade is unstable to such an extent that it cannot be removed and replaced with an approved material, the contract specifications should provide for the construction of a foundation consisting of piling, timbers or other material, in accordance with plans to be prepared by the engineer. The type of foundation will depend upon the conditions encountered.

In considering further the item of excavation and the preparation of the trench bottom, it should be mentioned that the depth of cover over water pipe should be determined by: [1] the maximum depth of frost penetration in the locality where the pipe is to be laid and [2] the direct effect of loaded trucks.

The depth of cover and the nature of the trench bottom are two primary factors in the determination of the thickness of the pipe metal. Studies made by ASA Committee A21 indicate that a cover of about 4 ft. with a flat-bottom trench and tamped backfill usually results in the most favorable resistance to the combination of earth and truck hazards.

Failures in cast-iron pipelines usually result from settlement, careless laying, flat-slope trenching, bedding on rock, improper backfilling procedure, impact from loaded trucks or rupture from freezing because of shallow cover. These and other external and internal hazards should be carefully considered before the line is laid.

It should be emphasized also that the blocking of pipe in the trench is looked

upon with considerable disfavor and is not recommended. Experiments indicate that the walls of a pipe supported by blocks must be thicker than those of one laid in a flat-bottom trench. There appears to be no doubt that the bearing strength of pipe laid in a flat-bottom trench, well tamped, is considerably greater than that of pipe laid and continuing to bear on blocking. Blocking, if used, should be recognized as a temporary expedient and the load should be transferred to the soil, tamped under the pipe as soon as possible.

Milwaukee Experience

In connection with this subject, it may be of interest that, over a period of many years, Milwaukee, Wis., followed the practice of excavating to slightly below the grade line of the pipe and then supporting the pipe on blocking. After the pipe was laid, the trench was backfilled with sand, gravel or other approved material and the backfill well puddled. Milwaukee has discontinued this practice and is at present following the procedure set forth in the A.W.W.A. specifications. The contractor is now required to excavate to below the grade line of the pipe. Before the pipe is laid, the subgrade is prepared by backfilling to grade with an approved material, which is tamped to provide a continuous bearing and support. The approved material is sand, gravel or a loam clay. After the pipe is laid to grade, additional approved material is placed and compacted by tamping from the bottom of the pipe to the centerline of the pipe.

When this procedure was adopted, it was decided to measure the amount of settlement obtained after the pipeline is laid and the trench backfilled to the subgrade of the pavement. The amount of settlement is found by taking levels on the pipeline before and after the trench is backfilled. After the pipeline is laid to grade, levels are taken in back of each bell. Valve boxes are then installed behind each bell and the trench is backfilled. Later levels are taken periodically through the valve boxes and the amount of settlement is obtained. The department has made observations up to the present on 54-, 42- and 12-in. pipe, and has obtained some interesting information on the amount of settlement for the different sizes with various depths of backfill tamped under the pipe and with several kinds of backfill material. It has been found that the settlement is greater with the large pipe but is quite uniform within each size, that it is greater with a larger depth of backfill material tamped under the pipe, and that it is less with a cohesive material like loam and clay than with a material like sand.

For 54-in. pipe and a 4-in. layer of compacted sand, a fairly uniform settlement of 0.07 ft. ($1\frac{3}{8}$ in.) was observed. With a 2-in. layer of compacted sand, this settlement was reduced to 0.06 ft. ($\frac{3}{4}$ in.). With a 1-in. layer of compacted sand placed on top of a 2-in. layer of compacted clay, the settlement observed was 0.05 ft. ($\frac{5}{8}$ in.). In each instance, the trench bottom was a blue clay.

With a 42-in. pipeline and 4 in. of compacted sand, a fairly uniform settlement of 0.06 ft. ($\frac{3}{4}$ in.) was observed. With 3 in. of compacted sand, the settlement was reduced to 0.05 ft. ($\frac{5}{8}$ in.); and with 2 in. of compacted sand, to 0.04 ft. ($\frac{1}{2}$ in.). In these instances, the trench bottom was sand or red clay.

With a 12-in. pipeline and 3 in. of compacted sand, a settlement of 0.02 ft. ($\frac{1}{4}$ in.) was observed. The trench bottom was a dry red clay.

Trench Width

The width of the trench will depend upon and vary with the size of the pipe, the depth of the trench and the nature of the excavated material encountered. It should be ample to permit the pipe to be laid and jointed properly and the backfill to be placed and consolidated. Trenches should be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting and bracing, and the handling of specials.

One item that the engineer should consider in specifying the allowable width of trench is the removal and replacement of pavement, which should be held down to a minimum consistent with the other requirements mentioned. Obviously, any pavement removed unnecessarily and replaced will increase the cost of the work.

The best procedure to follow in controlling the amount of pavement removed is to hold the contractor responsible for the replacement of pavement removed beyond the limits specified. If the contract requires the contractor to replace all pavement removed, the cost would, of course, be borne by the contractor. If, however, the contract documents provide that the owner will replace the pavement removed, then the cost of replacing the additional pavement should be deducted from monies due the contractor. Such costs can be determined from measurements and the cost of replacement or repairs, or from a schedule of fixed charges previously prepared by the owner and furnished to the contractor.

Laying Pipe

In laying the pipe, precautions should be taken to prevent foreign material from entering while the pipe is being placed in the line. The contract specifications should include provisions indicating that the engineer may require a heavy, tightly woven canvas bag of suitable size to be placed over each pipe end and left there until the connection is made to the adjacent pipe.

At times when pipe laying is not in progress, the open ends should be closed by a watertight plug or other approved means. Joints on pipe in the trench which for some reason cannot be poured immediately should be calked with packing to make them as watertight as possible.

When water mains are to be laid in railroad and street railway crossings, the engineer should consult with the railroad or street railway officials before preparing plans and specifications for this work. The company may require the work to be done according to a certain procedure and during certain hours. It may also insist upon doing some of the work itself and make charges for labor, material, supplies, supervision and inspection. Furthermore, the company may insist on dealing with the owner directly. Whatever the arrangements may be, they should be agreed upon prior to bidding so that there will be no misunderstanding on how and when the work is to be done, the apportionment of the work and the disposition of the cost, and any charges made by the company.

Jointing

In considering the jointing of bell-and-spigot cast-iron pipe, attention is called to the fact that a special committee of the Association made an investigation of the suitability of packing materials, and, as a result, the A.W.W.A. specifications include the following: [1] molded or tubular rubber rings; [2] asbestos rope; or [3] treated

paper rope. All of these materials should be handled with care in order to prevent contamination and should be dry when put into place in the joint.

The decision to exclude hemp, jute and braided cotton from the specifications is based on the recommendations of the committee on main disinfection. Technically there is a difference between hemp and jute, but what the water works utility usually receives when it specifies hemp is really jute, which must definitely be considered a source of contamination when used in the jointing of water mains. It is reported that the Twisted Jute Packing and Oakum Institute is now studying the matter in order to improve the materials.

Braided cotton was excluded because it is not a sterile compound and because there is very little demand for it by the water works industry.

The alternate jointing materials include lead and cement, and the details of the specifications for these materials do not differ appreciably from those included in the 1938 A.W.W.A. Standard Specifications for Laying Cast-Iron Pipe.

It is the practice, in certain localities where cement joints are used, to install some lead joints in the main to relieve possible strains on fittings or valves that might result from the extreme rigidity of a cement-jointed pipeline and also to speed up the completion of the final connections of a line in order to get it into service. One lead joint is poured at every gate valve, at every fire hydrant lateral and at intervals of about 500 ft. in a long line without valves and fittings. A lead joint at a fire hydrant may permit a twisting or deflecting of the connection when the hydrant is struck by an automobile, instead of resulting in a broken hydrant.

Although the committee recommended that mechanical joints or mechanically jointed pipe be included in the A.W.W.A. specifications, it was finally decided to omit them at this time. Instead, a special survey committee has been appointed with the task of reviewing experience to date in cities where mechanical-joint pipe has been used. This decision is in line with the policy of the Association and was made without intention to disparage the mechanical-joint pipe used extensively at the present time.

Hydrostatic Tests

After a pipeline has been laid, it is the usual practice to subject it to a pressure and leakage test, especially on the larger-size mains. The duration of such a pressure test should be at least one hour and it is conservative practice to use a test pressure 50 per cent above normal operating pressure. During this test all exposed pipes, fittings, valves, hydrants and joints should be examined. All lead joints showing visible leaks should be recalked until tight. Cement joints which show seepage or slight leakage should be cut out and replaced.

The duration of the leakage test should be two hours, and the pressure for the leakage test is usually set at the maximum operating pressure for the locality. Leakage is the quantity of water which must be supplied into the newly laid pipe to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

The 1938 specifications of the Association prescribed an allowable leakage equivalent to 100 gpd. per mile per inch nominal diameter for pipe in 12-ft.

lengths, evaluated on a pressure basis of 150 psi. The present specifications prescribe an allowable leakage equivalent to 70 gpd. on the same basis, or 30 gpd. less than the 1938 specifications.

In order to simplify the work of the engineer, there is included in the new specifications a table showing the allowable leakage in gallons per hour per 100 joints for various diameters of pipe and various test pressures. The diameters range from 2 to 60 in., and the average test pressures from 150 to 45 psi. in 5-psi. steps. Since the table shows the allowable leakage for 100 joints, it is a simple matter to determine the allowable leakage for the number of joints tested at various pressures in pipelines of various diameters.

Backfilling

All backfill material should be free from cinders, ashes, refuse, vegetable material, boulders, rocks or stones, or other material which, in the opinion of the engineer, is unsuitable. Where the excavation is made through permanent pavements, curbs, driveways or sidewalks, or where such structures are undercut by the excavation, it is advisable to use sand for the entire backfill up to the subgrade of the structure. This procedure will reduce the settlement to a minimum. Walks and driveways consisting of broken stone, gravel, slag or cinders should not be considered as being permanent construction.

There may be other locations where settlement is important and sand should be used as backfill. Those locations should be shown on the drawings wherever possible, or designated by the engineer when not shown on the drawings.

It is good practice, also, to encase the pipe, fittings and appurtenances in limestone screenings where muck, ash, refuse, cinders or acid soils are encountered.

In considering the procedure to follow in backfilling the trench, it appears logical to divide the work into three stages: [1] from the bottom of the pipe up to its centerline, [2] from the centerline of the pipe to a depth of 1 ft. above the top of the pipe and [3] from 1 ft. above the pipe to the subgrade of the pavement or to the grade shown on the drawings.

It is recommended that the backfill from the bottom of the pipe to the centerline be made by hand with sand, gravel or other approved material and that the material be placed in layers of about 3 in. and compacted by tamping. The backfill should be deposited simultaneously in the trench to its full width on each side of the pipe, fittings and appurtenances. It is believed that this procedure will aid materially in providing a uniform support for the pipe.

From the centerline of the pipe to 1 ft. above the top of the pipe, the trench should be backfilled by hand or by approved mechanical methods. The material used should be sand, gravel or approved excavated material.

From 1 ft. above the top of the pipe to the grade shown on the drawings, the trench should also be backfilled by hand or by approved mechanical means, and the material used should be sand, gravel or other approved excavated material.

The method of consolidating the backfill should be carefully considered by the engineer. Where settlement is important and sand, gravel and sandy loam are used, the material should be consolidated by puddling with a hose and long nozzle after the trench is backfilled. Where settlement is important and a material other than those

mentioned above is used, such material should be placed in 3-in. layers and compacted by tamping.

Where settlement is unimportant, the trench may be backfilled from the centerline of the pipe to the top of the trench with approved excavated material and the backfill neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation.

Removal and Restoration of Surface

In considering the provisions under removal, restoration and maintenance of surfaces, the A.W.W.A. specifications point out that it is inadvisable to attempt to prepare standard provisions for use in all localities. There are, however, certain fundamental principles that can be included.

In removing the pavement, the contractor should use such methods—either drilling or chipping—as will assure breaking the pavement along straight lines. The face of the cut in the remaining pavement should be approximately vertical.

Where any pavement, trees, shrubbery, fences, poles or other property or surface structures are damaged by the contractor, whether deliberately or through failure to carry out the requirements of the contract documents or to employ usual and reasonable safeguards, such property and surface structures should be replaced or repaired at the expense of the contractor.

In view of the fact that some cities do their own street repair work and others do not, it remains for the engineer to select the proper procedure for the particular situation.

Other Provisions

Cleaning up. When the work is completed, the site should be cleaned up. All surplus water main materials, tools, temporary structures, dirt, rubbish and excess earth from the excavation should be removed and the site left clean to the satisfaction of the engineer.

Maintenance of surface. Obviously, it is not possible to set forth uniform provisions which will adequately cover the maintenance of surfaces because cities follow different practices. It is advisable, however, to provide for the maintenance of unpaved trenches, curbs, sidewalks, gutters, shrubbery, sod or other disturbed surfaces for a stipulated period of time. Suitable provisions to cover this item should be included in the contract specifications.

Details and dimensions. In this discussion, many details and dimensions that are included in the A.W.W.A. specifications have been omitted. Such details include the minimum trench widths, maximum deflections for cast-iron bell-and-spigot pipe, number and size of blocks, additional pipe clearance in rock, depth of lead and cement joints, proportion of cement and water for cement joints, time interval before filling and testing pipe laid with cement joints, and quality of sand, gravel and screenings for backfill.

Relationship between engineer and contractor. There is one more important and worth-while thought which the engineer should have in mind in the preparation of the contract documents, including the drawings and specifications: he should follow well established engineering principles and make every effort to obtain a good job for the owner as economically as possible. He should remember also that the contractor is in business and is entitled to a reasonable profit. A good set of drawings and specifications will help to accomplish these objectives.

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American Water Works Association

Tentative

Standard Specifications

for

INSTALLATION OF CAST-IRON WATER MAINS

These "Tentative Standard Specifications for Installation of Cast-Iron Water Mains" are based upon the best known experience and are intended for use under normal conditions. They are not designed for unqualified use under all conditions and must be reviewed by the engineer responsible for the construction and modified as necessary to meet specific conditions pertaining to each individual installation.

Approved as Tentative by the Board of Directors of the A.W.W.A., June 3, 1949
Approval confirmed by the Executive Committee of the Board, November 14, 1949

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Committee Personnel

J. P. SCHWADA, *Chairman*

R. W. ESTY
W. A. GLASS
L. E. GOIT
H. A. HUNTER
H. W. NIEMEYER
G. J. REQUARDT
H. L. NELSON, *Adviser*
G. W. COFFIN, *N.E.W.W.A. Repr.*

Introduction

General

Standard specifications governing the construction of new water mains and the extension of existing mains must of necessity differ from specifications prepared for any particular project. Although both should include subject matter pertaining to the required work, materials and methods of construction, the latter can be made complete for any particular project by including therein a detailed description of the specific work, materials and methods applicable to that project. However, standard specifications, to be complete and serve their purpose, should include a detailed description of the several acceptable materials and methods of construction recognized as standard. Consequently, although the specifications for a particular project can be used without further supplementation, standard specifications must be accompanied by an appendix or addendum.

Standard Specifications and Addendum

The A.W.W.A. Specifications for Installation of Cast-Iron Water Mains can be made applicable to all water main construction projects by being supplemented with an adequate addendum for each project. The specifications presented herein include the various materials and methods of construction recognized as standard. The addendum, which must be prepared by the engineer, designates which of these various materials and methods of construction are to apply to a particular project. The addendum can also be expanded to cover work and materials not included in the specifications themselves.

Outline of Addendum

The "Outline of Addendum" included herein (p. 1107) is intended to guide and aid the engineer in the preparation of the addendum to accompany the A.W.W.A. Specifications for the Installation of Cast-Iron Water Mains.

Limits of A.W.W.A. Specifications

These specifications cover several procedures for laying and testing a system of water mains and for the furnishing of sheeting, blocking and joint materials incidental thereto. They do not cover the furnishing and delivery of pipes, castings, fittings, valves and hydrants by manufacturers, or the laying and jointing of any pipe other than cast iron.

These specifications do not include the detailed procedure for the disinfection of water mains following their construction. However, reference is made to a separate document prepared and approved by the A.W.W.A., entitled "A Procedure for Disinfecting Water Mains—7D.2–1947."

Use of A.W.W.A. Specifications

It is contemplated that the A.W.W.A. Specifications for Installation of Cast-Iron Water Mains may be of service in their published form as a part of the specifications to be incorporated in the contract documents. If it is decided to so use them, a statement having the following import should be made under the title "Specifications":

The water mains shall be laid and the work incidental thereto performed in accordance with the Specifications for Installation of Cast-Iron Water Mains adopted by the American Water Works Association on June 3, 1949, and the Addendum attached hereto.

General Requirements

Since the contract documents for the construction of any project include among them the "General Requirements," it is recommended that the definitions, notices and permits, regulations, schedule of minimum wages, means of measurement and payment for work on unit basis and as extra work, and similar items not covered by these specifications be included therein.

Tentative Standard Specifications for

Installation of Cast-Iron Water Mains

Section 1—Scope

Sec. 1.1—General

These specifications and the addenda attached hereto form a part of the contract documents.

Sec. 1.2—Work Included

The contractor shall, unless specified otherwise, furnish all material, equipment, tools and labor necessary to do the work required under this contract and unload, haul and distribute all pipe, castings, fittings, valves, hydrants and accessories. The contractor shall also remove the pavement as stipulated; excavate the trenches and pits to the required dimensions; excavate the bell holes; construct and maintain all bridges for traffic control; sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or ground water; provide barricades, guards and warning lights; lay and test the pipe, castings, fittings, valves, hydrants and accessories; backfill and consolidate the trenches and pits; restore the roadway surface unless otherwise stipulated; remove surplus excavated material; clean the site of the work; and maintain the street or other surface over the trenches as specified.

The contractor shall also furnish all equipment, tools, labor and materials required to rearrange branch connections to main sewers, or to rearrange sewers, conduits, ducts, pipes or other structures in accordance with the contract drawings and stipulations included herein.

Sec. 1.3—General Description of Work to Be Done

See Addendum Sec. 1.3.

Sec. 1.4—Schedule of Progress and Completion

See Addendum Sec. 1.4.

Sec. 1.5—List of Contract Drawings

See Addendum Sec. 1.5.

Sec. 1.6—Special Work to Be Performed

See Addendum Sec. 1.6.

Sec. 1.7—Materials to Be Furnished by Owner

See Addendum Sec. 1.7.

Sec. 1.8—Materials to Be Furnished by Contractor

See Addendum Sec. 1.8.

Sec. 1.9—Water Used

See Addendum Sec. 1.9.

Section 2—Inspection

Sec. 2.1—Shop Inspection

All materials furnished by the contractor are subject, at the discretion of the owner, to inspection and approval at the plant of the manufacturer. *See* Addendum Sec. 2.1.

Sec. 2.2—Field Inspection

All pipe and accessories shall be laid, jointed and tested under pressure for defects and leakage in the manner specified and in the presence of and as approved by the engineer.

Sec. 2.3—Disposition of Defective Material

All material found during the progress of the work to have cracks, flaws or other defects will be rejected by the engineer. All defective materials furnished by the contractor shall be promptly removed by him from the site. Any material furnished by the owner and found defective shall be set aside and removed from the site of the work by the owner.

Section 3—Responsibility for Material

Sec. 3.1—Responsibility for Material Furnished by Contractor

The contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work.

Sec. 3.2—Responsibility for Material Furnished by Owner

The contractor's responsibility for material furnished by the owner shall begin at the point of delivery thereof to said contractor. Materials already on the site shall become the contractor's responsibility on the day of the award of the contract. The contractor shall examine all material furnished by the owner at the time and place of delivery to him and shall reject all defective material. Any material furnished by the owner and installed by the contractor without discovery of such defects will, if found defective prior to final acceptance of the work, be replaced with sound material by the owner. The contractor, however, shall, at his own expense, furnish all supplies, labor and facilities necessary to remove said defective material and install the sound material in a manner satisfactory to the engineer.

Sec. 3.3—Responsibility for Safe Storage

The contractor shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

Sec. 3.4—Replacement of Damaged Material

Any material furnished by the owner that becomes damaged after acceptance by the contractor shall be replaced by the contractor at his own expense.

Section 4—Handling of Material

Sec. 4.1—Hauling

All materials furnished by the contractor shall be delivered and distributed at the site by the contractor. Materials furnished by the owner shall be picked up by the contractor at points designated in Addendum Sec. 4.1 and hauled to and distributed at the site.

Cast-iron pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

Sec. 4.2—At Site of Work

In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

Sec. 4.3—Care of Pipe Coating and Lining

Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the contractor at his expense in a manner satisfactory to the engineer.

Section 5—Alignment and Grade

Sec. 5.1—General

The water main shall be laid and maintained to the required lines and grades with fittings, valves and hydrants at the required locations; spigots centered in bells; and all valves and hydrant stems plumb.

Sec. 5.2—Deviations Occasioned by Other Structures

Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plan is required, the engineer shall have the authority to change the plans and order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation or reconstruction of the obstructions. If the change in plans results in a change in the amount of work by the contractor, such altered work shall be done on the basis of payment to the contractor for extra work or credit to the owner for less work. (*See* Note 5.2.)

Sec. 5.3—Caution in Excavation

The contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part.

Sec. 5.4—Subsurface Explorations

Whenever, in the opinion of the engineer, it is necessary to explore and excavate to determine the location of existing underground structures, the contractor shall make explorations and excavations for such purposes. If the contractor is required to perform additional work in making the explorations and excavations, extra compensation will be allowed for such additional work.

Sec. 5.5—Depth of Pipe

All pipe shall be laid to the depth shown on the contract drawings or as

required in Addendum Sec. 5.5. Any variation therefrom shall be made only at the order of the engineer. (*See* Note 5.5.)

Section 6—Excavation and Preparation of Trench

Sec. 6.1—Description

The trench shall be dug so that the pipe can be laid to the alignment and depth required, and it shall be excavated only so far in advance of pipelaying as specified in Addendum Sec. 6.1 or permitted by the engineer. The trench shall be so braced (Sec. 6.13 (p. 1088)) and drained that the workmen may work therein safely and efficiently. It is essential that the discharge of the trench dewatering pumps be conducted to natural drainage channels, drains or sewers.

Sec. 6.2—Width of Trench

The width of the trench shall be ample to permit the pipe to be laid and jointed properly, and the backfill to be placed and compacted as specified. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting and bracing, and handling of specials. *See* Addendum Sec. 6.2 *and* Note 6.2.

Sec. 6.3—Bell Holes

Bell holes shall be provided at each joint to permit the jointing to be made properly.

Sec. 6.4—Pipe Clearance in Rocks

Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6 in. below and on each side of all pipe, valves and fittings for pipes 24 in. in diameter or less, and 9 in. for pipes larger than 24 in. in diameter.

The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and appurtenances being laid and any part, projection or point of such rock, boulder or stone.

Sec. 6.5—Excavation to Grade

The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18 in. near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. Any part of the bottom of the trench excavated below the specified grade shall be corrected with approved material, thoroughly compacted as directed by the engineer. The finished subgrade shall be prepared accurately by means of hand tools.

The subgrade beneath the centerline of the pipe shall be finished to within 0.03 ft. of a straight line between pipe joints or batter boards, and all tolerances shall be above the specified grade.

If, in the opinion of the engineer, soil conditions are encountered at subgrade which require all or part of the work to be done in accordance with Sec. 6.6, the engineer shall have the authority to order the work to be so done, and the contractor will be allowed extra compensation for the additional work. *See* Sec. 6.10 (p. 1088) *and* Addendum Sec. 6.5; *see also* Note 6.5 (a) *and* Note 6.5 (b).

Sec. 6.6—Excavation Below Grade

The trench shall be excavated to at least 3 in. and not more than 6 in. below the specified grade. Before the

pipe is laid, the subgrade shall be made by backfilling with an approved material in 3-in. uncompacted layers. The layers shall be thoroughly tamped as directed by the engineer so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18 in. near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools.

The subgrade beneath the centerline of the pipe shall be finished to within 0.03 ft. of a straight line between pipe joints or batter boards, and all tolerances shall be above the specified grade. *See* Sec. 6.10 (p. 1088) *and* Addendum Sec. 6.6; *see also* Note 6.5 (a) *and* Note 6.6.

Sec. 6.7—Excavation in Poor Soil and Refilling to Grade

Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, all types of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material which in the judgment of the engineer should be removed, the contractor shall excavate and remove such unsuitable material to the width and depth ordered by the engineer. Before the pipe is laid, the subgrade shall be made by backfilling with an approved material in 3-in. uncompacted layers. The layers shall be thoroughly tamped as directed by the engineer so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18 in. near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools.

The subgrade beneath the centerline of the pipe shall be finished to within 0.03 ft. of a straight line between pipe joints or batter boards, and all tolerances shall be above the specified grade.

The contractor will be allowed extra compensation for the additional work. *See* Sec. 6.10 *and* Note 6.5 (a).

Sec. 6.8—Special Foundation in Poor Soil

Where the bottom of the trench at subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the engineer, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the contractor shall construct a foundation for the pipe, consisting of piling, timbers or other materials, in accordance with plans prepared by the engineer. Extra compensation will be allowed for the additional work.

Sec. 6.9—Subgrade in Rock Trenches

Where excavation is made in rock or boulders and the clearance specified in Sec. 6.4 is provided, the subgrade shall be made by backfilling with an approved material in 3-in. uncompacted layers. The layers shall be thoroughly tamped as directed by the engineer so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18 in. near the middle of each pipe length by the withdrawal of

pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately with hand tools.

The subgrade beneath the centerline of the pipe shall be finished to within 0.03 ft. of a straight line between pipe joints or batter boards, and all tolerances shall be above the specified grade. *See* Sec. 6.10.

Sec. 6.10—Subgrade for Blocking

Where blocking is ordered in accordance with Sec. 8 (p. 1091), the trench shall be excavated to at least 2 in. and not more than 4 in. below the specified grade and the blocking laid as specified.*

Where, in the opinion of the engineer, the bottom of the trench at subgrade is found to be unsuitable for blocking, the engineer shall have the authority to order additional excavation and backfilling with an approved material, which shall be placed in 3-in. uncompacted layers and thoroughly tamped to an elevation of 2 in. below the specified grade so as to support the blocking properly.

The contractor will be allowed extra compensation for the additional work. *See* Addendum Sec. 6.10 *and* Note 6.5 (a).

Sec. 6.11—Rock Excavation

The word "rock," wherever used as the name of an excavated material, shall mean boulders and pieces of concrete or masonry exceeding 250 lb. in weight, or solid ledge rock and masonry which, in the opinion of the engineer, requires for its removal drilling and blasting, wedging, sledging or barring, or breaking up with a power-operated hand tool. No soft or disintegrated rock which can be removed with a hand pick or power-operated excavator or shovel; no loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere; and no rock exterior to the minimum limits of measurement allowed, which may fall into the excavation, will be measured or allowed.

Sec. 6.12—Blasting

Blasting for excavation will be permitted only after securing the approval of the engineer and only when proper precautions are taken for the protection of persons or property. The hours of blasting will be fixed by the engineer. Any damage caused by blasting shall be repaired by the contractor at his expense. The contractor's methods of procedure in blasting shall conform to state laws and municipal ordinances.

Sec. 6.13—Braced and Sheeted Trenches

Open-cut trenches shall be sheeted and braced as required by any governing state laws and municipal ordinances, and as may be necessary to protect life, property or the work. When close sheeting is required, it shall be so driven as to prevent adjacent soil from entering the trench either below or through such sheeting. Where sheeting and bracing are used, the trench width shall be increased accordingly.

The engineer reserves the right to order the sheeting driven to the full depth of the trench or to such additional depths as may be required for the protection of the work. Where the soil in the lower limits of a trench has the necessary stability, the engineer, at his discretion, may permit the contractor to stop the driving of sheeting at some designated elevation above the trench bottom. The granting of permission by the engineer, however, shall not relieve the contractor in any de-

* Blocking is not recommended. *See* p. 1091.

gree from his full responsibility under the contract.

Sheeting and bracing which have been ordered left in place must be removed for a distance of 3 ft. below the established street grade or the existing surface of the street, whichever is lower. Trench bracing, except that which must be left in place, may be removed when the backfilling has reached the respective levels of such bracing. Sheeting, except that which has been left in place, may be removed after the backfilling has been completed or has been brought up to such an elevation as to permit its safe removal. Sheeting and bracing may be removed before flushing the trench, but only in such manner as will insure the adequate protection of the completed water structures and adjacent underground or surface structures, and prevent the disturbance of adjacent ground.

The cost of furnishing, placing and removing the sheeting and bracing and the leaving in place of sheeting and bracing indicated on the plans shall be included in the price bid for the work. When sheeting and bracing have been ordered by the engineer, or when such sheeting and bracing have been ordered left in place by the engineer, the payment for same shall be as an extra. When sheeting and bracing have been ordered left in place, payment for same shall include the upper 3 ft. or "cut-off" section of the sheeting.

Sec. 6.14—Care of Surface Material for Reuse

All surface materials which, in the opinion of the engineer, are suitable for reuse in restoring the surface shall be kept separate from the general excavation material, as directed by the engineer.

Sec. 6.15—Piling Excavated Material

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

Sec. 6.16—Trenching by Hand or Machine

Hand methods for excavation shall be employed in locations shown on the drawings. In other locations the contractor may use trench-digging machinery or employ hand methods.

Sec. 6.17—Barricades, Guards and Safety Provisions

To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the highway. All material piles, equipment and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the local authorities respecting safety provisions shall be observed.

Sec. 6.18—Maintenance of Traffic and Closing of Streets

The contractor shall carry on the work in a manner which will cause the least interruption to traffic, and may

close to through travel not more than two consecutive blocks, including the cross street intersected. Where traffic must cross open trenches, the contractor shall provide suitable bridges at street intersections and driveways.

The contractor shall post, where directed by the engineer, suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic.

Sec. 6.19—Structure Protection

Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the contractor at his expense and under the direction of the engineer. The structures which may have been disturbed shall be restored upon completion of the work.

Sec. 6.20—Protection of Property and Surface Structures

Trees, shrubbery, fences, poles and all other property and surface structures shall be protected unless their removal is shown on the drawings or authorized by the engineer. When it is necessary to cut roots and tree branches, such cutting shall be done under the supervision and direction of the engineer. *See* Sec. 15.3 (p. 1102).

Sec. 6.21—Interruption of Service

No valve or other control on the existing system shall be operated for any purpose by the contractor. The owner will operate all valves, hydrants, blow-offs and curb stops.

Section 7—Laying

Sec. 7.1—Handling of Water Main Material Into Trench

Proper implements, tools and facilities satisfactory to the engineer shall be provided and used by the contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

Sec. 7.2—Hammer Test

The pipe and fittings shall be inspected for defects and, while suspended above grade, be rung with a light hammer to detect cracks.

Sec. 7.3—Cleaning Pipe and Fittings

All lumps, blisters and excess coal-tar coating shall be removed from the bell-and-spigot end of each pipe, and the outside of the spigot and the inside of the bell shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

Sec. 7.4—Laying Pipe

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, the engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris,

tools, clothing or other materials shall be placed in the pipe.

After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space.

At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the engineer. Joints of pipe in the trench which cannot be poured (*see* Sec. 7.5) shall be calked with packing to make them as watertight as possible. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

Sec. 7.5—Number of Pipes Laid Before Jointing

Wherever the jointing material specified is cement, six or more lengths of pipe shall be in place ahead of each joint before such joint is finished.

Sec. 7.6—Cutting Pipe

The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

When machine cutting is not available for cutting pipe 20 in. in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. Only qualified and experienced workmen shall be used on this work.

The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed.

Sec. 7.7—Bell Ends to Face Direction of Laying

Pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the engineer.

Sec. 7.8—Permissible Deflection at Joints

Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or plumb stems, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory calking of the joint, and shall be approved by the engineer. *See* Addendum Sec. 7.8 *and* Note 7.8.

Sec. 7.9—Railroad and Street Railway Crossings

See Addendum Sec. 7.9.

Sec. 7.10—Unsuitable Conditions for Laying Pipe

No pipe shall be laid in water or when, in the opinion of the engineer, trench conditions are unsuitable.

Section 8—Blocking

Blocking of cast-iron pipe is not recommended and is not ordinarily used in modern practice. When special conditions indicate the desirability of the use of blocking, the following statements are indicative of an accept-

able method. These comments also govern the application of Sec. 6.10 and Note 8.3.

Sec. 8.1—Support Required

See Sec. 6.10 *and* Addendum Sec. 8.1.

Sec. 8.2—General

Pipe shall be laid on wood blocking and held in position by wood wedges. Blocking and wedges shall be cut from sound lumber.

Sec. 8.3—Dimensions

The number and size of blocks shall be as specified in Addendum Sec. 8.3. (*See* Note 8.3.)

Sec. 8.4—Spacing of Blocks

Blocks shall be placed 3 ft. from the joint where only one block is used per length of pipe, 4 ft. from the joint where two blocks are used for pipes 16 ft. long, and 5 ft. from the joint where two blocks are used for pipes 18 ft. and 20 ft. long.

Sec. 8.5—Placing of Wood Blocking

Blocks shall be bedded firmly with uniform bearing and with the long side tangent and crosswise to the outside of the pipe barrel. Blocks shall not be embedded in any manhole or buttress or act as a support for such structures.

Section 9—Jointing

Sec. 9.1—Yarning or Packing Material

Yarning or packing material shall consist of one of the following: [1] molded or tubular rubber rings, [2] asbestos rope or [3] treated paper rope. All of the above materials shall be handled with care in order to prevent contamination and shall be dry when put into place in the joint. The material used shall be free of oil, tar or greasy substances. In cement joints, the yarning material may be omitted if so specified. *See* Addendum Sec. 9.1.

Sec. 9.2—Placing of Yarning Material

The yarning material shall be placed around the spigot of the pipe and shall be of proper dimensions to center the spigot in the bell. When the spigot is shoved home, the yarning material shall be driven tightly against the inside base or hub of the bell with suitable yarning tools.

When a single strand of yarning material is used, it shall have an overlap at the top of not more than 2 in. When more than a single strand is required for a joint, each strand shall be cut to sufficient length so that the ends will meet without causing overlap. The ends of the strands shall meet on opposite sides of the pipe and not on the top or at the bottom. Successive strands of yarning material shall be driven home separately.

Sec. 9.3—Depth of Jointing Material

For lead joints a space not less than 2¼ in. in depth shall be left in the bell in pipe having a nominal diameter of 20 in. or less; 2½ in. in 24-, 30- and 36-in. pipe; and 3 in. in pipe larger than 36 in.

When cement is specified, a space not less than 3 in. in depth shall be left in the bell unless it is specified that the yarning material or packing shall be omitted. *See* Addendum Sec. 9.1.

Sec. 9.4—Lead Joints

See Addendum Sec. 9.4.

Sec. 9.5—Lead

Lead for calking purposes shall contain not less than 99.73 per cent pure lead. Impurities shall not exceed the following limits:

	per cent
Arsenic, antimony & tin together	0.015
Copper	0.08
Zinc	0.002
Iron	0.002
Bismuth	0.25
Silver	0.02

The producer's name or the mark of Lead Industries shall be clearly cast or stamped upon each piece of lead.

Sec. 9.6—Heating and Pouring of Lead

Lead shall be heated in a melting pot kept in easy reach of the joint to be poured—so that the molten metal will not be chilled in being carried from the melting pot to the joint—and shall be brought to a proper temperature so that when stirred it will show a rapid change of color. Before pouring, all scum shall be removed. Each joint shall be made with one continuous pour filling the entire joint space with solid lead. Spongy or imperfectly filled joints shall be burned out and repoured.

Sec. 9.7—Position of Joint Runner

The joint runner shall fit snugly against the face of the bell and the outside of the pipe and shall be dammed with clay to form a pouring lip to provide for filling the joint flush with the face and to the top of the bell.

Sec. 9.8—Calking Lead Joints

After the lead has cooled to the temperature of the pipe, lead joints shall be calked with pneumatic or hand tools operated by competent workmen, until such joints are thoroughly compacted and watertight. The finished joint shall show a hard and even hammered surface overall. Care should be taken not to overstrain the bells during calking.

Sec. 9.9—Cement Joints

See Addendum Sec. 9.9 *and* Note 9.9.

Sec. 9.10—Cement

All cement shall be of an approved brand acceptable to the engineer and shall comply with the current specifications of the American Society for Testing Materials.

Sec. 9.11—Proportions of Cement and Water

One quart of cement shall be thoroughly mixed with about ¼ pint of water. The mixture shall be such that when it is tightly compressed by hand into a ball and the ball is broken into two pieces, the break shall be clean. If the hand is water-stained, the mixture is too wet. If there is evidence of crumbling in the break, the mixture is too dry. The cement mixture shall ring with a metallic sound while being calked.

Sec. 9.12—Cause for Rejection

No cement shall be used after having been wet more than one hour or after its initial set.

Sec. 9.13—Calking Cement Joints

Starting at the bottom, the joint space shall be filled with the cement mixture and the mixture calked. The remaining joint space shall then be

refilled and calked until the joint is practically flush with the face of the bell. The mixture shall be thoroughly compacted to make a watertight joint without overstraining the bell.

Sec. 9.14—Trench Water and Initial Set

No water shall be allowed to touch the joint until the initial set has taken place.

Sec. 9.15—Joints Kept Moist Until Set

Cement joints shall be covered immediately with damp burlap, or other material approved by the engineer, for the proper time to insure complete hydration. In cold weather, care shall be taken to prevent freezing of the cement mixture before and after the joint is made.

Sec. 9.16—Time Interval Before Filling Pipe

Pipe laid with cement joints shall not be filled with water until a lapse of twelve hours after the last joint in any valved section has been made, and pressure shall not be permitted in the pipe until all joints have aged as provided in Sec. 13.10 (p. 1099).

Note: Certain materials are omitted from the preceding list, pending the completion of investigations now in progress. See *Note 9 (p. 1105)*.

Note: Although mechanical joints are being used in water works pipe-laying practice, no specification for their use is included herein, pending the study of mechanical joints and the completion of a specification therefor under the direction of a recently authorized committee established for that purpose by the Association.

Section 10—Setting Valves and Fittings

Sec. 10.1—General

Valves, fittings, plugs and caps shall be set and jointed to pipe in the manner heretofore specified for cleaning, laying and jointing pipe.

Sec. 10.2—Location of Valves

Valves in water mains shall, where possible, be located on the street property lines extended unless shown otherwise on the plans.

Sec. 10.3—Valve Boxes and Valve Pits

A valve box or a masonry pit shall be provided for every valve.

A valve box shall be provided for every valve which has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a cast-iron grease case. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.

A masonry valve pit shall be provided for every valve which has exposed gearing or operating mechanisms. The valve nut shall be readily accessible for operation through the opening in the manhole, which shall be set flush with the surface of the finished pavement or such other level as may be specified. Pits shall be so constructed as to permit minor valve repairs and afford protection to the valve and pipe from impact where they pass through the pit walls.

Sec. 10.4—Drainage of Mains

Mains shall be drained through drainage branches or blowoffs to dry wells from which the water can be pumped. Drainage branches, blowoffs, air vents and appurtenances shall be provided with gate valves and shall be located and installed as shown on the plans.

Drainage branches or blowoffs shall not be connected to any sewer, submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system.

Sec. 10.5—Dead Ends

All dead ends on new mains shall be closed with cast-iron plugs or caps, with or without a blowoff cock, as shown on the drawings.

Section 11—Setting Hydrants

Sec. 11.1—Location

Hydrants shall be located as shown or as directed and in a manner to provide complete accessibility, and also in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized.

When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 6 in. nor more than 12 in. from the gutter face of the curb.

When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 6 in. of the sidewalk.

Sec. 11.2—Position

All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb, with the pumper nozzle facing the curb, except that hydrants having two hose nozzles 90 deg. apart shall be set with each nozzle facing the curb at an angle of 45 deg. Hydrants shall be set to the established grade, with nozzles at least 12 in. above the ground, as shown or as directed by the engineer.

Sec. 11.3—Connection to Main

Each hydrant shall be connected to the main with a 6-in. cast-iron branch controlled by an independent 6-in. gate valve, except as otherwise directed.

Sec. 11.4—Hydrant Drainage in Pervious Soil

Wherever a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand, from the bottom of the trench to at least 6 in. above the waste opening in the hydrant and to a distance of 1 ft. around the elbow. No drainage system shall be connected to a sewer. *See* Note 11.4 *and* Addendum Sec. 11.4.

Sec. 11.5—Hydrant Drainage in Impervious Soil

Wherever a hydrant is set in clay or other impervious soil, a drainage pit 2 ft. in diameter and 3 ft. deep shall be excavated below each hydrant and filled compactly with coarse gravel or crushed stone mixed with coarse sand, under and around the elbow of the hydrant and to a level of 6 in. above the waste opening. No drainage pit shall be connected to a sewer. *See* Addendum Sec. 11.5.

Section 12—Anchorage

Sec. 12.1—Anchorage for Hydrants

The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with stone slabs or concrete backing, or it shall be tied to the pipe with suitable metal tie rods or clamps, as shown or directed by the engineer. *See* Addendum Sec. 12.1.

Sec. 12.2—Anchorage for Plugs, Caps, Tees and Bends

All plugs, caps, tees and bends deflecting 22½ deg. or more on mains 8 in. in diameter or larger shall be provided with a reaction backing, or movement shall be prevented by attaching suitable metal rods or clamps as shown or specified.* *See* Note 12.2.

Sec. 12.3—Reaction Backing

Reaction backing shall be concrete of a mix not leaner than 1 cement: 2½ sand: 5 stone, and having a compressive strength of not less than 2,000 psi. at 28 days. Backing shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be that shown or directed by the engineer. The backing shall, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair. *See* Addendum Sec. 12.3.

Sec. 12.4—Metal Harness

Metal harness of tie rods or clamps of adequate strength to prevent movement may be used instead of concrete backing, as directed by the engineer. Steel rods or clamps shall be galvanized or otherwise rustproof treated, or shall be painted as shown or directed by the engineer. *See* Addendum Sec. 12.4.

Section 13—Hydrostatic Tests

Sec. 13.1—Hydrostatic Tests Required

See Addendum Sec. 13.1.

Sec. 13.2—Pressure Test

After the pipe has been laid and partially backfilled as specified in Sec. 14.5, all newly laid pipe, or any valved section thereof, shall be subjected to the hydrostatic pressure stated in Addendum Sec. 13.2. If specified in Addendum Sec. 13.11, or if directed by the engineer, the contractor shall backfill the trench in accordance with Sec. 14.7 before making the pressure test. *See* Sec. 13.11.

Sec. 13.3—Duration of Pressure Test

The duration of each pressure test shall be at least one hour.

Sec. 13.4—Procedure

Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gage, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the engineer. The pump, pipe connection and all necessary apparatus except

* NOTE: Consideration is being given by the committee to the rewording of Sec. 12.2 as follows: "All plugs, caps, tees and bends deflecting 22½ deg. or more on mains 8 in. in diameter or larger shall, unless otherwise indicated, be anchored to prevent movement by providing suitable reaction backing or metal harness therefor, as shown on the plans or specified herein."

gages shall be furnished by the contractor. The owner will furnish the gages for the test and will make all taps into the pipe, but the contractor shall furnish all necessary assistance for conducting the tests.

Sec. 13.5—Expelling Air Before Test

Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blowoffs are not available at high places, the owner shall make the necessary taps at points of highest elevation before the test is made and insert the plugs after the test has been completed.

Sec. 13.6—Examination Under Pressure

All exposed pipes, fittings, valves, hydrants and joints will be carefully examined during the open-trench test. When the joints are made with lead, all such joints showing visible leaks shall be recalked until tight. When the joints are made with cement and show seepage or slight leakage, such joints as may be defective shall be cut out and replaced by the contractor as directed by the engineer. Any cracked or defective pipes, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced by the contractor with sound material in the manner provided under Sec. 3, and the test shall be repeated until satisfactory to the engineer.

Sec. 13.7—Leakage Test

A leakage test shall be conducted after the pressure test has been satisfactorily completed. The owner will furnish the gage and measuring device for the leakage test. The contractor shall furnish the pump, pipe, connections and all other necessary apparatus, and shall furnish all necessary assistance to conduct the test. The duration of each leakage test shall be two hours, and during the test the main shall be subjected to the pressure stated in Addendum Sec. 13.7.

Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

No pipe installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = \frac{ND\sqrt{P}}{1{,}850}$$

in which L equals the allowable leakage, in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gage. (The allowable leakage according to the formula is equivalent to 70 U.S. gal. per 24 hours per mile of pipe per inch nominal diameter, for pipe in 12-ft. lengths evaluated on a pressure basis of 150 psi.)

The allowable leakage at various pressures for pipe of various diameters is shown in Table 1.

Sec. 13.8—Variation From Permissible Leakage

Should any test of pipe laid disclose leakage greater than that specified in Section 13.7, the contractor shall at his own expense locate and repair the defective joints until the leakage is within the specified allowance.

Sec. 13.9—Time for Making Test of Lead-jointed Pipe

Lead-jointed pipe may be subjected to hydrostatic pressure and inspected

TABLE 1

Allowable Leakage for Various Pressures and Pipe Diameters

Avg. Test Pressure *psi.*	Allowable Leakage per 100 Joints—*gph.* (U.S.)*																	
	Pipe Diameter—*in.*																	
	2	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60
150	1.33	1.99	2.65	3.97	5.30	6.62	7.94	9.27	10.59	11.92	13.24	15.89	19.86	23.83	27.81	31.78	35.75	39.72
145	1.30	1.95	2.60	3.91	5.21	6.51	7.81	9.11	10.41	11.72	13.02	15.62	19.53	23.43	27.34	31.24	35.15	39.05
140	1.28	1.92	2.56	3.84	5.12	6.40	7.68	8.95	10.23	11.51	12.79	15.35	19.19	23.03	26.86	30.70	34.54	38.38
135	1.25	1.88	2.51	3.77	5.02	6.28	7.54	8.79	10.05	11.30	12.56	15.07	18.84	22.61	26.38	30.15	33.92	37.68
130	1.25	1.85	2.47	3.70	4.93	6.16	7.40	8.63	9.86	11.09	12.33	14.79	18.49	22.19	25.89	29.58	33.28	36.98
125	1.21	1.81	2.42	3.63	4.84	6.04	7.25	8.46	9.67	10.88	12.09	14.50	18.13	21.76	25.38	29.01	32.64	36.26
120	1.18	1.78	2.37	3.55	4.74	5.92	7.11	8.29	9.47	10.66	11.84	14.21	17.76	21.32	24.87	28.42	31.97	35.53
115	1.16	1.74	2.32	3.48	4.64	5.80	6.96	8.12	9.28	10.43	11.59	13.91	17.39	20.87	24.35	27.82	31.30	34.78
110	1.13	1.70	2.27	3.40	4.54	5.67	6.80	7.94	9.07	10.20	11.34	13.61	17.01	20.41	23.81	27.21	30.61	34.02
105	1.11	1.66	2.22	3.32	4.43	5.54	6.65	7.75	8.86	9.97	11.08	13.29	16.62	19.94	23.26	26.59	29.91	33.23
100	1.08	1.62	2.16	3.24	4.32	5.41	6.49	7.57	8.65	9.73	10.81	12.97	16.22	19.46	22.70	25.95	29.19	32.43
95	1.05	1.58	2.11	3.16	4.22	5.27	6.32	7.38	8.43	9.48	10.54	12.64	15.81	18.97	22.13	25.29	28.45	31.61
90	1.02	1.54	2.05	3.08	4.10	5.13	6.15	7.18	8.21	9.23	10.26	12.31	15.38	18.46	21.54	24.61	27.69	30.77
85	0.99	1.50	1.99	2.99	3.99	4.98	5.98	6.98	7.97	8.97	9.97	11.96	14.95	17.94	20.93	23.92	26.91	29.90
80	0.96	1.45	1.93	2.90	3.87	4.84	5.80	6.77	7.74	8.70	9.67	11.60	14.50	17.41	20.31	23.21	26.11	29.01
75	0.93	1.40	1.87	2.81	3.75	4.68	5.62	6.55	7.49	8.43	9.36	11.24	14.04	16.85	19.66	22.47	25.28	28.09
70	0.90	1.36	1.81	2.71	3.62	4.52	5.43	6.33	7.24	8.14	9.05	10.85	13.57	16.28	18.99	21.71	24.42	27.14
65	0.87	1.31	1.74	2.61	3.49	4.36	5.23	6.10	6.97	7.84	8.72	10.46	13.07	15.69	18.30	20.92	23.53	26.15
60	0.83	1.26	1.67	2.51	3.35	4.19	5.02	5.86	6.70	7.54	8.37	10.05	12.56	15.07	17.59	20.10	22.61	25.12
55	0.80	1.20	1.60	2.41	3.21	4.01	4.83	5.61	6.41	7.22	8.02	9.62	12.03	14.43	16.84	19.24	21.65	24.05
50	0.76	1.15	1.53	2.29	3.06	3.82	4.59	5.35	6.12	6.88	7.64	9.17	11.47	13.76	16.05	18.35	20.64	22.93
45	0.72	1.09	1.45	2.18	2.90	3.63	4.35	5.08	5.80	6.53	7.25	8.70	10.88	13.05	15.23	17.41	19.58	21.76

* If the Imperial gallon is used the figures must be reduced one-sixth.

The allowable leakage for a pipeline is calculated by multiplying the leakage per hour per 100 joints at the average test pressure and for the diameter of pipe tested as obtained from the above table, by the duration of the test in hours and the total number of joints in the line divided by 100. If the section under test contains joints of various diameters, the allowable leakage will be the sum of the computed leakage for each size of joint.

and tested for leakage at any convenient time after the trench has been partially backfilled except at the joints in accordance with Sec. 14.6, or backfilled in accordance with Sec. 14.7, if specified or directed by the engineer (*see* Sec. 13.11). The leakage allowance shall be that specified in Sec. 13.7.

Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early-strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.

Sec. 13.10—Time for Making Test of Cement-jointed Pipe

Pipes jointed with cement shall not be subjected to hydrostatic pressure and inspected and tested for leakage until at least 36 hours have elapsed after the main was filled with water as specified in Sec. 9.16. Pipelines shall remain full of water until all tests have been made. The pressure test, inspection and leakage test shall be made after the trench has been partially backfilled except at the joints in accordance with Sec. 14.6, or backfilled in accordance with Sec. 14.7, if specified or directed by the engineer (*see* Sec. 13.11). The leakage allowance shall be that specified in Sec. 13.7.

Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early-strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.

Sec. 13.11—Pressure and Leakage Tests After Backfilling

After the trench has been backfilled in accordance with Sec. 14.7, the test connections made and the main filled with water, the test sections shall be subjected to water pressure normal to the area. After examination of exposed parts of the system, the test pressure will be increased to the hydrostatic pressure specified in Addendum Sec. 13.2 and exposed parts again examined. If defects are found, the contractor shall immediately make the necessary repairs at his own expense. The engineer will then repeat the pressure test until no defects are found. The duration of the final pressure test shall be at least one hour.

The leakage test shall be conducted after satisfactory completion of the pressure test, in accordance with Sec. 13.7. Should any test section fail to meet the leakage test, the contractor shall make the necessary repairs at his own expense. *See* Addendum Sec. 13.11.

Section 14—Backfilling

Sec. 14.1—Backfill Material

All backfill material shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks or stones, or other material which in the opinion of the engineer is unsuitable. However, from 1 ft. above the top of the pipe to the subgrade of the pavement, material containing stones up to 8 in. in their greatest dimension may be used, unless specified otherwise herein.

Sec. 14.2—Use of Excavated Material as Backfill

When the type of backfill material is not indicated on the drawings or specified, the contractor may backfill with the excavated material, provided that such material consists of loam clay, sand, gravel or other materials which, in the opinion of the engineer, are suitable for backfilling. Where excavated material is indicated on the drawings or specified for backfill and there is a deficiency due to a rejection of part thereof, the contractor shall furnish the required amount of sand, gravel or other approved material as an extra.

Sec. 14.3—Sand or Gravel Backfill

Where sand or gravel backfill is not indicated on the drawings or specified herein, and in the opinion of the engineer should be used in any part of the work, the contractor shall furnish and backfill with sand or gravel as directed as an extra.

Sec. 14.4—Limestone Screenings Backfill

Where shown on the drawings or specified in the Addendum, or where directed by the engineer, the contractor shall completely encase the pipe, fittings and appurtenances in limestone screenings 1 ft. thick and complete the backfilling of the trench as shown or directed by the engineer. The limestone screenings shall be placed in layers 3 in. thick and compacted by tamping to the bottom of the trench at subgrade as required in Sec. 6.7 if blocking is not used, and to about 1 in. below the subgrade as required in Sec. 6.10 if blocking is used. Above these elevations the limestone screenings shall be placed in layers 3 in. thick and compacted by tamping under the pipe, fittings and appurtenances to the centerline, as required in Sec. 14.5. From the centerline to 1 ft. above the pipe, fittings and appurtenances, the limestone screenings shall be placed as specified in Addendum Sec. 14.4. The contractor shall be allowed extra compensation for excavating, furnishing and placing the limestone screenings where such work is not shown on the drawings or specified. *See* Note 14.4 *and* Addendum Sec. 14.4.

Sec. 14.5—Backfilling Under Pipe

All trenches—whether the pipe, fittings and appurtenances are laid on a flat bottom at subgrade in accordance with Sec. 6.5 or laid on blocking in accordance with Sec. 6.10—shall be backfilled by hand, from the bottom of the trench to the centerline of the pipe, with sand, gravel or other approved material placed in layers of 3 in. and compacted by tamping. Backfilling material shall be deposited in the trench for its full width on each side of the pipe, fittings and appurtenances simultaneously.

Sec. 14.6—Backfilling Over Pipe

From the centerline of the pipe, fittings and appurtenances to a depth of 1 ft. above the top of the pipe, the trench shall be backfilled by hand or by approved mechanical methods. The contractor shall use special care in placing this portion of the backfill so as to avoid injuring or moving the pipe. See Addendum Sec. 14.6 for the type of backfill material required and the method of placing and consolidating.

Sec. 14.7—Backfilling to Grade

From 1 ft. above the pipe to the grade shown on the drawings or specified herein, the trench shall be backfilled by hand or by approved mechanical methods. See Addendum Sec. 14.7

for the type of backfill required and the method of placing and consolidating.

Sec. 14.8—Backfill Under Permanent Pavement

Where the excavation is made through permanent pavements, curbs, driveways or sidewalks or where such structures are undercut by the excavation, the entire backfill to the subgrade of the structures shall be made with sand. Walks and driveways consisting of broken stone, gravel, slag or cinders shall not be considered as being of a permanent construction. See Addendum Sec. 14.8 for the method of placing and consolidating the backfill material.

Sec. 14.9—Backfilling Where Settlement Unimportant

Where shown on the drawings or specified, the contractor may backfill the trench from 1 ft. above the pipe to the top of the trench with the excavated material, and the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation. See Addendum Sec. 14.9.

Sec. 14.10—Backfilling in Freezing Weather

Backfilling shall not be done in freezing weather except by permission of the engineer, and it shall not be made with frozen material. No fill shall be made where the material already in the trench is frozen.

Sec. 14.11—Backfill Sand

All sand used for backfill shall be a natural bank sand, graded from fine to coarse, not lumpy or frozen, and free from slag, cinders, ashes, rubbish or other material which, in the opinion of the engineer, is objectionable or deleterious. It shall not contain a total of more than 10 per cent by weight of loam and clay, and all material must be capable of being passed through a $\frac{3}{8}$-in. sieve. Not more than 5 per cent shall remain on a No. 4 sieve.

Sec. 14.12—Backfill Gravel

Gravel used for backfill shall consist of natural bank gravel having durable particles graded from fine to coarse in a reasonably uniform combination with no boulders or stones larger than 2 in. in size. It shall be free from slag, cinders, ashes, refuse or other deleterious or objectionable materials. It shall not contain excessive amounts of loam and clay and shall not be lumpy or frozen. No more than 15 per cent shall be finer than No. 200 sieve.

Sec. 14.13—Backfill Limestone Screenings

Screenings shall consist of the product obtained from crushing sound limestone or dolomite ledge rock and shall be free from shale, dust, excessive amounts of clay and other undesirable materials. All materials shall pass a $\frac{1}{2}$-in. sieve and no more than 25 per cent shall be finer than a No. 100 sieve.

Section 15—Removal, Restoration and Maintenance of Surface

Sec. 15.1—Allowable Removal of Pavement

The contractor shall remove pavement and road surfaces as a part of the trench excavation, and the amount removed shall depend upon the width of trench specified for the installation of the pipe and the width and length of the pavement area required to be removed for the installation of gate valves, specials, manholes or other

structures. The width of pavement removed along the normal trench for the installation of the pipe shall not exceed the width of the trench specified by more than 6 in. on each side of the trench. The width and lengths of the area of pavement removed for the installation of gate valves, specials, manholes or other structures shall not exceed the maximum linear dimensions of such structures by more than 6 in. on each side. Wherever, in the opinion of the engineer, existing conditions make it necessary or advisable to remove additional pavement, the contractor shall remove it as directed by the engineer and shall receive extra compensation therefor, provided such additional work is not shown in the drawings or specified. The contractor shall use such methods, either drilling or chipping, as will assure the breaking of the pavement along straight lines. The face of the remaining pavement shall be approximately vertical. *See* Addendum Sec. 15.1.

If the contractor removes or damages pavement or surfaces beyond the limits specified above, such pavement and surfaces shall be replaced or repaired at the expense of the contractor as specified in Sec. 15.2.

Sec. 15.2—Restoration of Damaged Surfaces and Property

Where any pavement, trees, shrubbery, fences, poles or other property and surface structures have been damaged, removed or disturbed by the contractor, whether deliberately or through failure to carry out the requirements of the contract documents, state laws, municipal ordinances or the specific direction of the engineer, or through failure to employ usual and reasonable safeguards, such property and surface structures shall be replaced or repaired at the expense of the contractor. If Addendum Sec. 15.3 specifies that the replacements or repairs shall be made by the contractor, he shall replace or repair and restore said structures to a condition equal to that before the work began, furnishing all labor and materials incidental thereto. If Addendum Sec. 15.4 specifies that the replacement or repairs will be made by the owner, the cost of the replacements or repairs will be deducted from monies due the contractor. Costs shall be determined by the engineer from measurements and the cost of replacement or repairs, or from a schedule of fixed charges previously prepared by the owner and furnished the contractor. *See* Addendum Sec. 15.2.

Sec. 15.3—Replacement of Pavement and Structures by Contractor

The contractor shall restore (unless otherwise stipulated) all pavement, sidewalks, curbing, gutters, shrubbery, fences, poles, sod or other property and surface structures removed or disturbed as a part of the work to a condition equal to that before the work began, furnishing all labor and materials incidental thereto. In restoring the pavement, sound granite blocks, sound brick or asphalt paving blocks may be reused. No permanent pavement shall be restored unless and until, in the opinion of the engineer, the condition of the backfill is such as to properly support the pavement. *See* Addendum Sec. 15.3.

Sec. 15.4—Replacement of Pavement and Structures by Owner

The owner will restore (unless otherwise stipulated) all pavements, sidewalks, curbing, gutter, shrubbery, fences, poles, sod or other property and surface structures removed or dis-

turbed as a part of the work. *See* Addendum Sec. 15.4.

Sec. 15.5—Cleaning up

All surplus water main materials furnished by the contractor and all tools and temporary structures shall be removed from the site by the contractor. All dirt, rubbish and excess earth from the excavation shall be hauled to a dump provided by the contractor and the construction site left clean to the satisfaction of the engineer. All surplus water main materials furnished by the owner and delivered to the site by the contractor shall be removed and delivered by the contractor to a location designated by the owner. All surplus water main material furnished and delivered by the owner shall be removed by the owner.

Sec. 15.6—Maintenance of Surface

See Addendum Sec. 15.6.

NOTES

The boldface numerals at the beginning of each note refer to the section of the specification to which the note relates.

5.2. In a specification of this kind it is not possible to set forth the rights and responsibilities of the owner and of the utilities and others owning structures that may have to be removed, relocated or reconstructed, because such rights and responsibilities vary in different localities. Then, too, the owners of certain structures may insist on doing all or part of the work involved at the expense of the owner installing the water main. It is recommended that an investigation be made when the plans are prepared and the rights and responsibilities of all parties involved be considered in allocating the work to be done. When obstructions not shown on the plans are encountered during the progress of the work, the rights and responsibilities of the parties involved will also determine the allocation of the work and costs.

5.5. The minimum depth of cover over water pipe should be determined by: [1] the maximum depth of frost penetration in the locality where the pipe is to be laid and [2] the direct effect of loaded trucks.

The depth of cover and the nature of the trench bottom are two primary factors in the determination of metal thicknesses. Metal thicknesses, as developed from calculations by the American Standards Assn. Committee A21, take into account four distinct trench conditions and two types of backfill and varying depth of cover. A cover of about 4 ft. with a flat-bottom trench and tamped backfill usually results in the most favorable combination of earth and truck hazard.

Where failures in cast-iron pipelines occur, they usually result from settlement, careless laying, flat-slope trenching, bedding on rock, improper backfilling procedure, impact from loaded trucks or rupture from freezing because of shallow cover. These and other external and internal hazards should be carefully considered before the line is laid.

For full details of the design of cast-iron pipe for various pressures and trench conditions, refer to findings of American Standards Assn. Committee A21 on Specifications for Cast-Iron Pipe.

6.2. The width of trench will depend upon and vary with the size of the pipe, the depth of the trench and the nature of the excavated material encountered. However, it should pro-

vide for the minimum removal and replacement of pavement consistent with the requirements of Sec. 6.2.

The minimum widths shown in Table 2 represent the best judgment obtainable thereon for use where the soil is fairly stable and for depths of trench varying from about 6 to 12 ft. For each size of pipe, the minimum widths of earth shown provide a clearance of about 4 in. on each side of the bell of the pipe.

TABLE 2

Minimum Trench Widths

Nom. Pipe Diam. *in.*	Minimum in Earth *in.*	Minimum in Rock *in.*
2	18	24
3	18	24
4	18	24
6	21	24
8	24	24
10	26	26
12	28	28
18	31	31
20	33	33
24	36	36
30	40	40
36	47	47
42	54	54
48	61	61
54	68	68
60	75	75

Where shallow trenches are used, the widths may be less than those shown in the table.

6.5(a). The type of pipe foundation described in Sec. 6.5 is preferable to the alternative specified under Sec. 8—Blocking. Experiments indicate that the walls of the pipe supported by blocks must be thicker than one laid in a flat-bottom trench, in order to stand the same internal pressure and external loads. There appears to be no doubt that the bearing strength of pipe laid in a flat-bottom trench, well tamped or puddled, is considerably greater than if the pipe is laid and continues to bear on blocking. Consideration must be given to the type of trench, method of backfilling and use of blocks, if any, when specifying the metal thickness of pipe required in any particular installation.

Other factors affecting pipe thickness—such as water hammer, excessive earth loads, truck loads, foundry tolerance and corrosion—should also be considered. For full details of the design of cast-iron pipe for various pressures and trench conditions, refer to findings of American Standards Assn. Committee A21 on Specifications for Cast-Iron Pipe. From these findings, blocking, if used, should be recognized as a temporary expedient and the load should be transferred to the soil tamped under the pipe as soon as possible.

6.5(b). Excavating to the grade line is recommended when the soil at subgrade is uniformly good, and stones, dry clay, hard pan, shale or cemented gravel are not exposed.

6.6. Excavating below the grade line and backfilling is recommended when the soil at subgrade is not uniformly good, and stones, dry clay, hard pan, shale or cemented gravel are exposed. In some localities, this procedure is followed even when the soil at subgrade is uniformly good, in order to eliminate the final trimming of the trench bottom by hand, improve drainage conditions and obtain more rapid progress.

7.8. The deflection of a pipeline may be obtained by opening the joints, thereby permitting one side of the spigot end of the pipe to be away from home when the other side is touching the hub of the bell. However, an adequate depth of jointing material should always be provided on the side where the spigot is away from

home, and an adequate width of calking space on the opposite side of the pipe at the face of the bell.

The maximum deflections shown in Table 3 recognize the limitations which should be observed when deflecting cast-iron bell-and-spigot pipe.

8.3. The number and size of blocks for various sizes and lengths of pipe shown in Table 4 represent a practice used satisfactorily in some localities.

9. Other materials have been extensively used in the jointing of cast-iron pipe. Pending the completion of an investigation of the performance of sulfur jointing compounds, these materials are not included in the specifications. Directions covering their use are herewith included, for the guidance of those who may employ these materials. These directions are reprinted from the 1938 Specifications for Laying Cast-Iron Pipe, prepared and published by the A.W.W.A.:

Sec. 10.5—Sulfur Compound Joints: Compound for pipe joints shall be of approved make and of established reputation. It shall have a sulfur base and other ingredients properly proportioned to produce a workable compound, and tight and permanent joints.

10.51 *Manufacturer's Instructions to Be Followed:* The compound shall be heated in a melting furnace suitable for the use of sulfur compound and manipulated in accordance with the instructions of the manufacturer of the compound.

10.52 *Proper Condition for Pouring:* It shall be stirred thoroughly and continuously while melting, and until used. When poured it must be very liquid, free from froth or bubbles or any foreign matter and shall show a mirror-like surface.

10.53 *Making the Joint:* Suitable funnel-shaped metal pouring gates extending not less than 8 in. above the bell shall be adequately clayed to the joint runner. The joint space and gate shall be filled with one continuous pour while the compound is at the proper temperature. The solidified compound in the pouring gate shall be cut off flush with the top of the bell or broken off flush with the top of the joint.

10.54 *Replacing Defective Joints:* If a joint is defective, it shall be cut out and entirely replaced as directed by the engineer.

10.55 *Burned Compound Rejected:* Any compound burned in the melting pot shall be dumped out and not reused.

9.9. It is the practice in certain localities where cement joints are used to install some lead joints in the main to relieve possible strains on fittings or valves that might result from the extreme rigidity of a cement-jointed pipeline and also to speed up the completion of the final connections of a line in order to get it into service. One lead joint is poured at every gate valve, at every fire hydrant lateral and at intervals of about 500 ft. in a long line without valves or fittings. Sometimes two or three lead joints are poured for speed in completing the final connections. A lead joint at a fire hydrant may permit a twisting or deflecting of the connection when the hydrant is struck by an automobile instead of resulting in a broken hydrant.

11.4. Proper drainage of waste water from a hydrant is very important where there is a possibility of the water freezing in the barrel of the hydrant, and where this may occur a drainage system that will dispose of the waste water rapidly should be used. Where ground water may enter the hydrant through the waste openings and contaminate the water supply, it is recommended that the waste openings be plugged and the waste water removed from the barrel immediately after the hydrant has been used.

12.2. Section 12.2 does not apply to

TABLE 3—*Maximum Deflections of Cast-Iron Bell-and-Spigot Pipe**

Nom. Pipe Diam.	Joint Opening	Max. Deflection With Pipe Length of:				Approx. Radius of Curve Produced by Succession of Joints With Pipe Lengths of:			
		12 ft.	16 ft.	18 ft.	20 ft.	12 ft.	16 ft.	18 ft.	20 ft.
	in.					*ft.*			
2	0.41	23.6	31.5	35.4	39.4	73	98	110	122
3	0.43	14.8	19.7	22.2	24.7	112	149	168	186
4	0.41	11.1	14.8	16.7	18.5	156	208	234	260
6	0.58	11.1	14.8	16.7	18.5	156	208	234	260
8	0.65	9.7	12.9	14.6	16.2	178	238	268	297
10	0.75	9.3	12.4	14.0	15.5	186	248	279	310
12	0.75	7.9	10.5	11.9	13.2	218	292	327	363
14	0.75	6.7	8.9	10.1	11.2	258	345	387	430
16	0.75	5.9	7.9	8.8	9.7	293	390	440	488
18	0.75	5.3	7.1	8.0	8.8	326	434	489	543
20	0.75	4.8	6.4	7.2	8.0	360	480	540	600
24	0.75	4.0	5.3	6.0	6.7	432	577	648	720
30	0.75	3.3	4.4	5.0	5.5	524	699	786	873
36	0.75	2.8	3.7	4.2	4.7	617	824	926	1,028
42	0.75	2.4	3.2	3.6	4.0	720	960	1,080	1,200
48	0.75	2.1	2.8	3.2	3.5	823	1,097	1,234	1,371
54	0.75	1.9	2.5	2.9	3.2	909	1,211	1,364	1,515
60	0.75	1.7	2.3	2.6	2.8	1,016	1,355	1,524	1,695

* Limiting factors: [1] joint opening not to exceed 0.75 in.; [2] calking space at face of bell to be not less than 0.25 in. in width.

TABLE 4—*Number and Size of Blocks*

Pipe id. *in.*	No. of Blocks Required		Block Dimensions*—*in.*		
	12-ft. Length or Less	Over 12-ft. Length	Thickness	Width	Length
2	1	2	2	6	8
3	1	2	2	6	9
4	1	2	2	6	10
6	1	2	2	6	12
8	1	2	2	6	14
10	1	2	2	6	16
12	1	2	2	6	18
16	1	2	4	6	22
18	2	2	4	6	24
20	2	2	4	6	26
24	2	2	4	6	30
30	2	2	4	6	36
36	2	2	6	6	42
42	2	2	6	6	48
48	2	2	6	8	54
54	2	2	6	8	60
60	2	2	6	8	66

* Wedges should be 2 × 2 × 6 in. long. Larger-sized blocks should be used where necessary to support valves and fittings.

suction pipelines or, at the discretion of the engineer, to low-pressure pipelines less than 12 in. in diameter.

14.4. It is considered good practice to encase the pipe, fittings and appurtenances in limestone screenings when muck, ash, refuse, cinders or acid soil is encountered in the excavation.

SPECIAL NOTE

Disinfection of Water Mains

The disinfection of newly laid water mains is not included in these specifications because usually the owner is better equipped to do the work and because the amount of the work involved cannot be estimated.

It is recommended that upon completion of a newly laid main or when repairs to an existing line are made, the main be disinfected according to "A Procedure For Disinfecting Water Mains—7D.2–1947," prepared and approved by the A.W.W.A. on September 30, 1947.

OUTLINE OF ADDENDUM

If the Specifications in their published form are to be used, the engineer should prepare and include as a part of the Specifications an addendum, entitled "Addendum to the Specifications for Installation of Cast-Iron Water Mains." Since the specifications include the various standard materials that may be used and the several standard methods that may be followed, the engineer should select the materials and methods that apply to the project and, by reference to the sections in the Specifications, indicate in the addendum those which do or do not apply.

The engineer should include in the addendum information pertaining to subject matter referred to in certain sections of the Specifications which cannot therein be completely covered and made applicable to all projects. The engineer may also include in the addendum information to cover work and materials not included in the Specifications.

The following is a guide to aid the engineer in preparing the addendum. (The section and paragraph numbers below correspond to the related sections of the Specifications.)

Sec. 1—Scope

1.3—General Description of Work to Be Done. The work to be done under these specifications consists of laying approximately ..... linear feet of .....-inch water main in ..... Street from ..... Street to ..... Street.

NOTE: The engineer should include a general description of the work to be done and the location of the work. A suitable breakdown of the work to be done is desirable.

1.4—Schedule of Progress and Completion. The work in ..... Street shall be started by ....., 19..... and shall be completed by ....., 19.....

NOTE: If various parts of the work are to be started and completed at different times, the engineer should include a suitable breakdown.

1.5—List of Contract Drawings. The contract drawings which apply to these Specifications and Addendum are listed below:

Drawing No.	Title	File No.
.....	.....	.....
.....	.....	.....

1.6—Special Work to Be Performed.

NOTE: The engineer should specify any special work required which is not covered by the Specifications for Installation of Cast-Iron Water Mains. It may include a section of pipe other than cast-iron and laid under another A.W.W.A. specification, or other structures covered by specifications

prepared by the engineer. If no special work is required, it should be so stated.

1.7—Materials to Be Furnished by Owner. The owner will furnish the following materials:

No. of Pieces	Class	Description	Approx. Weight	Delivery Point
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

NOTE: The engineer should also specify what materials, if any, are to be unloaded by the contractor from railroad cars. If no materials are to be furnished by the owner, the engineer should so specify.

1.8—Materials to Be Furnished by Contractor. The following is a partial estimate of materials to be furnished and delivered by the contractor:

No. of Pieces	Class	Description	Approx. Weight
.....	.....	.....	.....
.....	.....	.....	.....

NOTE: The engineer should include all materials required and not furnished by the owner.

1.9—Water Used. Water for testing mains, puddling trenches and drinking purposes will be made available to the contractor at the existing facilities of the owner at a charge of ..... The contractor shall furnish all necessary pipe or hose extensions or transportation to the point of use. The contractor shall exercise care in the use of the water.

NOTE: If the water is to be furnished by the owner without charge, or if the contractor is to furnish the water at his expense, it should be so stated in lieu of the above requirement.

Sec. 2—Inspection

2.1—Shop Inspection. The inspection at the plant of the manufacturer of materials furnished by the contractor shall be made at the expense of the owner or contractor.

NOTE: The engineer should include a list of the materials furnished by the contractor and subject to inspection at the plant of the manufacturer and state whether the inspection shall be made at the expense of the owner or contractor.

Sec. 4—Handling of Material

4.1—Hauling. The contractor shall pick up the materials furnished by the owner, as set forth in Sec. 1.7 of the Addendum, at the delivery points specified, haul the materials to and distribute them at the site.

NOTE: If the materials furnished by the owner are not to be picked up, hauled to and distributed at the site by the contractor, this should be stated. If part of the material furnished by the owner is to be handled by the contractor, the engineer should here list these materials in a table similar to the one included in Sec. 1.7 of the Addendum.

Sec. 5—Alignment and Grade

5.5—Depth of Pipe. The centerline of all pipe shall be laid to a minimum depth of ..... feet ..... inches below established grade.

NOTE: The above specification should only be included if the contract drawings do not show the grade line.

Sec. 6—Excavation and Preparation of Trench

6.1—Description. Not more than ..... linear feet of trench shall be dug in advance of the completed pipe-laying operation.

6.2—Width of Trench. The width of trench for the various sizes of pipe and locations shown shall be as follows:

NOTE: The engineer should here include a table showing the size of pipe and width of trench for various locations.

6.5—Excavation to Grade. The trench shall be excavated in accordance with Sec. 6.5. Sections 6.6 and 6.10 shall not apply, *or*

6.6—Excavation Below Grade. The trench shall be excavated in accordance with Section 6.6. Sections 6.5 and 6.10 shall not apply, *or*

6.10—Subgrade for Blocking. The trench shall be excavated in accordance with Sec. 6.10. Sections 6.5 and 6.6 shall not apply.

NOTE: The engineer should here include one of the above requirements.

Sec. 7—Laying

7.8—Permissible Deflection at Joints. Whenever it is necessary to deflect pipe from a straight line, the deflection shall not exceed the following amounts:

NOTE: The engineer should here include a table showing the maximum permissible deflections.

7.9—Railroad and Street Railway Crossings.

NOTE: The engineer is advised to consult with the railroad or street railway company before preparing plans and specifications for this part of the work. The company may require the work to be done according to a certain procedure and during certain hours. It may insist also upon doing some of the work itself and make charges for labor, material, supplies, supervision and inspection. Furthermore, the company may insist on dealing with the owner. However, whatever, the arrangements may be, they should be agreed upon prior to bidding so that there will be an understanding on how and when the work is to be done, the apportionment of the work and the disposition of the cost and any charges made by the company.

The engineer should here include a specification for the installation of the mains under railroad and street railway crossings in accordance with the plans and procedure agreed upon.

The engineer should also here specify that "Where a main is laid under a single track, it shall be constructed so that the center point of a full length of pipe lies midway between the rails of such single track. Where the main is laid under multiple tracks, it shall be constructed so that the joints lie midway between the tracks."

Sec. 8—Blocking

8.1—Support Required. Blocking as specified in Sec. 8 shall be provided, *or*

Blocking as specified in Sec. 8 shall not be provided.

NOTE: The engineer should here include one of the above requirements.

8.3—Dimensions. The number and size of blocks specified in Sec. 8.3 shall be used.

NOTE: If Sec. 8.3 does not apply, the engineer should here so state and include the number and sizes of blocks that shall be used.

Sec. 9—Jointing

9.1—Yarning or Packing Material. The yarning or packing material shall be .....

NOTE: The engineer should here state which material shall be used. If cement joints are used and the yarning or packing material is to be omitted, the engineer should here so specify. If some lead joints are to be used with the cement joints, the engineer should here specify the yarning or packing material that should be used with the lead joints.

9.4—Lead Joints. All sections pertaining to lead joints shall apply and all sections pertaining to cement joints shall not apply, *or*

9.9—Cement Joints. All sections pertaining to cement joints shall apply and all sections pertaining to lead joints shall not apply.

NOTE: The engineer should here include one of the above requirements.

Sec. 11—Setting Hydrants

11.4—Hydrant Drainage in Pervious Soil. This section shall apply and Sec. 11.5 shall not apply, *or*

11.5—Hydrant Drainage in Impervious Soil. This section shall apply and Sec. 11.4 shall not apply.

NOTE: The engineer should here specify one of the above requirements. If the soil conditions are not known, the engineer should specify that the type of hydrant drainage will be selected after the excavation of the trench.

Sec. 12—Anchorage

12.1—Anchorage for Hydrants. The anchorage for hydrants shall consist of stone slabs or concrete backing, *or*

The anchorage for hydrants shall consist of metal rods or clamps.

NOTE: The engineer should here specify one of the above requirements.

12.3—Reaction Backing. This section shall apply and Sec. 12.4 shall not apply, *or*

12.4—Metal Harness. This section shall apply and Sec. 12.3 shall not apply.

NOTE: The engineer should here include one of the above requirements.

Sec. 13—Hydrostatic Tests

13.1—Hydrostatic Tests Required. Hydrostatic tests as specified in Sec. 13.2–13.9 inclusive shall apply for lead joints and Sec. 13.10 shall not apply, *or*

Hydrostatic tests as specified in Sec. 13.2–13.8 inclusive and Sec. 13.10 shall apply for cement joints and Sec. 13.9 shall not apply.

NOTE: The engineer should here include one of the above requirements.

13.2—Pressure Test. The hydrostatic pressure shall be ..... pounds per square inch, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gage.

NOTE: A test pressure 50 per cent above normal operating pressure is considered conservative practice.

13.7—Leakage Test. The hydrostatic pressure shall be ..... pounds per equare inch, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gage.

NOTE: The pressure for the leakage test is usually set at the maximum operating pressure for the locality.

13.11—Pressure and Leakage Tests After Backfilling. The contractor shall backfill the trench before making the pressure and leakage tests.

NOTE: The engineer should here include the above requirement if the trench is to be backfilled before the tests are made.

Sec. 14—Backfilling

14.4—Limestone Screenings Backfill. This section shall (*or* shall not) apply.

NOTE: If the drawings show all the locations where limestone screening backfill shall be placed, the engineer should state that this section shall apply. If the drawings do not show all or any of the locations, the engineer should state that this section shall apply and here specify the additional locations or all of the locations. If this section shall not apply, the engineer should so specify.

14.6—Backfilling Over Pipe. The backfill material from the centerline of the pipe to 1 ft. above the pipe shall consist of:

1. Sand which shall be puddled with hose and long pipe nozzle after the trench is backfilled, *or*

2. Gravel which shall be puddled with hose and long pipe nozzle after the trench is backfilled, *or*

3. Approved excavated material which shall be puddled with hose and long pipe nozzle after the trench is backfilled, *or*

4. Approved excavated material which shall be placed in 3-in. layers and compacted by tamping.

NOTE: The engineer should here include one of the above requirements or any other requirement which is to be followed. The type of backfill material and the method of placing and compacting depends upon the importance of settlement. It also depends upon the type of pavement or surface. Puddling should not be done until the trench is backfilled. If more than one type of material and method of backfilling is required, the drawings or the Addendum should indicate the limits of each.

14.7—Backfilling to Grade. The backfill material from 1.0 ft. above the pipe to the street grade (or subgrade of pavement) shall consist of:

1. Sand which shall be puddled with hose and long pipe nozzle after the trench is backfilled, *or*

2. Gravel which shall be puddled with hose and long pipe nozzle after the trench is backfilled, *or*

3. Approved excavated material which shall be puddled with hose and long pipe nozzle after the trench is backfilled, *or*

4. Approved excavated material which shall be placed in 3-in. layers and compacted by tamping.

NOTE: The engineer should here include one of the above requirements or any other requirement which is to be followed. The type of backfill material and the method of placing and compacting depends upon the importance of settlement. It also depends upon the type of pavement or surface. Puddling should not be done until the trench

is backfilled. If more than one type of material and method of backfilling is required, the drawings or the Addendum should indicate the limits of each.

14.8—Backfill Under Permanent Pavement. This section shall (*or* shall not) apply.

NOTE: If this section applies, the engineer should here include the method of placing and consolidating.

14.9—Backfilling Where Settlement Unimportant. This section shall (*or* shall not) apply.

NOTE: If this section applies, the engineer should show on the drawings or here include the limits.

Sec. 15—Removal, Restoration and Maintenance of Surface

15.1—Allowable Removal of Pavement.

NOTE: If the requirements of Sec. 15.1 are not applicable, the engineer should so state and prepare requirements that do apply.

15.2—Restoration of Damaged Surfaces and Property. This section shall apply and the cost of the replacement or repairs will be determined by the engineer from measurements and the costs incurred (or from a schedule of fixed charges, or from a combination of both).

NOTE: The engineer should here include a statement showing how the costs will be determined. Some cities do the repaving and restoration of sidewalk, curb, gutter and driveways with their own forces and furnish the bidders with a schedule of fixed unit prices.

15.3—Replacement of Pavement and Structures by Contractor. This section shall (*or* shall not) apply.

NOTE: If the drawings do not show the type of replacement, the engineer should here specify the materials to be used.

15.4—Replacement of Pavement and Structures by Owner. This section shall (*or* shall not) apply.

15.6—Maintenance of Surface. Following the certification of completion by the engineer, the contractor shall maintain the surface of the unpaved trenches, curbs, sidewalks, gutters, shrubbery, fences, sod and other surfaces disturbed for a period of three months thereafter; and shall maintain the repaved areas (if paved by the contractor) and curbs, gutters and sidewalks for one year after said certification.

All material and labor required for the maintenance of the trenches and adjacent structures shall be supplied by the contractor and the work shall be done in a manner satisfactory to the engineer.

NOTE: If the above paragraph does not apply in its entirety, the engineer should prepare a suitable paragraph.

Special Note—Extra Work

The Specifications for Installation of Cast-Iron Water Mains include provisions for payment for extra work in Sec. 5.2, 5.4, 6.5, 6.7, 6.8, 6.10, 6.13, 14.2 and 14.4, and the engineer should include means of measurement and payment for such extra work elsewhere in the contract documents.

Constitution and By-Laws Amendments

There follows a review of the amendments to the A.W.W.A. Constitution and By-Laws which were approved during 1949.

Amendment to A.W.W.A. Constitution

The following amendment to Article II (Object) of the Association's Constitution was approved by the members, by letter ballot, as of September 1, 1949, and becomes effective January 1, 1950:

Article II is changed to read:

The objects of this Association shall be:

(1) to advance the knowledge of the design, construction, operation and management of water works;

(2) to consider and deal with the problems involved in the production and distribution of safe and adequate supplies of water;

(3) to promote satisfactory relationships with the consuming public;

(4) to give proper consideration to and express opinions upon practices which will enable the industry to render the best possible service to the public;

(5) to do whatever things are necessary and proper for the accomplishment of the objectives herein set forth, all of which shall be consistent with the public interest and with the interests of the water works industry.

The membership of the Association consists of persons interested in such matters and who are in accord with the above objectives. Qualifications for and classifications of membership shall be as prescribed in the By-Laws.

Amendments to A.W.W.A. By-Laws

The following amendments to Article II (Admission and Expulsion) of the Association's By-Laws were approved by the Board of Directors, by letter ballot, as of February 21, 1949:

The second paragraph of Section 2.1 is changed to read:

Applications for Associate Membership shall provide adequate information concerning the ownership, corporate structure and financial standing of the applicant; and the experience of the customers in the water works industry with the applicant firm. When such information has been received by the Secretary, he shall refer it to the Executive Committee of the Board for consideration and approval or rejection. The Executive Committee shall establish such detailed criteria for Associate Membership as it deems necessary to the discharge of this duty. These criteria, when approved by the Board, may be, in the case of failure of a member to continue satisfactory business practices, the basis for expulsion from membership under the terms of Section 6 hereinafter.

The closing paragraph of Section 2.1 is transferred to Section 2.2, which will now read:

2.2. Applications shall be forwarded by the Secretary to the Board for approval when the above conditions have been met. An affirmative vote of a majority of the Board shall elect and the applicant shall become a member when his annual dues shall have been paid.

Section 3 is changed to read:

No member whose dues are in arrears for three months shall receive the publications of the Association until such arrears are paid. Members in arrears for one year shall be automatically dropped by the Secretary from the list of members.

7B.2-T

American Water Works Association

Tentative

Standard Specifications

for

REINFORCED CONCRETE WATER PIPE—STEEL CYLINDER TYPE, PRESTRESSED

These "Tentative Standard Specifications for Reinforced Concrete Water Pipe—Steel Cylinder Type, Prestressed" are based upon the best known experience and are intended for use under normal conditions. They are not designed for unqualified use under all conditions and must be reviewed by the engineer responsible for the construction and modified as necessary to meet specific conditions pertaining to each individual installation.

Approved as Tentative by the Board of Directors of the A.W.W.A. on November 21, 1949

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AMERICAN WATER WORKS ASSOCIATION
Incorporated
500 Fifth Avenue, New York 18, N.Y.

Prepared by

Water Works Practice Committee E7B

Personnel

ERNEST W. WHITLOCK, *Chairman*

LEO V. GARRITY
DWIGHT D. GROSS
CLYDE C. KENNEDY
M. W. LOVING
HOWARD F. PECKWORTH
FRED D. PYLE
ROBERT A. SKINNER
MAX K. SOCHA

Manufacturers' Advisers

ELLIOTT E. BRAINARD
ROBERT V. EDWARDS

N.E.W.W.A. Representatives

STANLEY M. DORE
GEORGE A. SAMPSON

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Tentative Standard Specifications for

Reinforced Concrete Water Pipe—Steel Cylinder Type, Prestressed

Section 2–1—General

Sec. 2–1.1—Scope

These specifications cover the manufacture of circumferentially prestressed reinforced concrete water pipe with steel cylinder in sizes from 16 to 48 in., inclusive, designed for static heads ranging from a minimum of 100 ft. to a maximum of 600 ft. The specifications do not include delivery, laying, field testing or sterilization of the pipe.

Sec. 2–1.2—Definitions

In these specifications the following definitions will apply:

1.2.1. *Purchaser.* The word "purchaser" shall mean a person, firm, corporation or governmental subdivision entering into a contract or agreement to purchase any materials, or have any work performed, according to these specifications.

1.2.2. *Contractor.* The word "contractor" shall mean the person, firm or corporation executing the contract or agreement with the purchaser to furnish any materials or perform any work according to these specifications.

1.2.3. *Manufacturer.* The word "manufacturer" shall mean the person, firm or corporation who actually manufactures the pipe, acting either directly as the contractor, or as a subcontractor. If the manufacturer is acting as a subcontractor under the contractor, the obligations of the manufacturer under these specifications shall be considered as obligations of the contractor, and the contractor shall be responsible for their performance.

1.2.4. *Engineer.* The word "engineer" shall mean the engineer employed by the purchaser and acting as his representative; the purchaser himself, acting as his own engineer; and their respective assistants and inspectors.

1.2.5. *A.S.T.M.* The term "A.S.T.M." shall mean the American Society for Testing Materials. When specific A.S.T.M. specifications are cited, the designation shall be construed to refer to any subsequent revision under the same specification number, or superseding specifications under a new number, except as to provisions in the revised specifications which clearly are inapplicable.

1.2.6. *Approved.* The term "approved" shall mean having received the approval of the engineer.

Sec. 2–1.3—Essential Requirements

The pipe shall have the following principal features: a welded sheet-steel cylinder with steel joint rings welded to its ends; a lining of dense concrete within the steel cylinder; reinforcement consisting of high-tensile wire wound around the outside of the steel cylinder at a predetermined tension and securely fastened to it at its ends; a coating of dense mortar or concrete covering the

cylinder and wire except for necessarily exposed surfaces of the joint rings; a self-centering joint with a preformed gasket of rubber, so designed that the joint will be watertight under all conditions of service.

Sec. 2–1.4—Plans and Data Furnished by Purchaser

It is understood that the purchaser shall furnish to the contractor plans and profiles of the pipeline showing: alignment and grades; the location of all outlets, connections and special appurtenances; the design head for each portion of the pipeline; and such special details as are necessary for the manufacture of the pipe and fittings in accordance with these specifications and with the specific requirements of the work for which the pipe is made.

Sec. 2–1.5—Supplementary Details Specified by Purchaser

When purchasing pipe under these specifications, it will be necessary for the purchaser to make supplementary statements specifying: the manner of storage and delivery, if these are required of the contractor or manufacturer; and the type of specials and fittings to be furnished.

Sec. 2–1.6—Data Submitted by Contractor

1.6.1. Drawings and schedules showing full details of reinforcement, concrete and joint dimensions for the pipe shall be furnished by the contractor. All drawings and schedules shall be submitted for approval in quadruplicate, and one copy shall be returned to the contractor after approval. No pipe shall be manufactured until the drawings have been approved.

1.6.2. When specifically required, the data submitted by the contractor shall include a tabulated layout schedule, with reference to the stationing and grade line shown on the contract drawings. The schedule shall show pressure zones, each of which shall be designated by the design head applicable therein, and the point of change from one zone to the next shall be clearly indicated by station number. The diameter of pipe, the design head, and the thickness of pipe wall and area of steel (per linear foot of pipe) in the reinforcing wire and steel cylinder shall be listed for each portion of pipeline for which the design head or the equivalent internal pressure is fixed by the purchaser.

Sec. 2–1.7—Marking

Each special and each length of straight pipe shall have plainly marked on the bell end the identification marks specified by the purchaser. These shall include, as specified, either the head for which the pipe or special is designed or the area of effective circumferential reinforcement per foot of pipe wall. Special marks of identification, sufficient to show the proper location of the pipe or special in the line by reference to layout drawings and schedules specified under Sec. 2–1.6 of these specifications, shall be placed on the pipe if specifically required. All beveled pipe shall be marked with the amount of the bevel.

Sec. 2–1.8—Inspection

1.8.1. The purchaser and his representatives shall have access to the work wherever it is in preparation or progress, and the contractor shall provide proper facilities for access and for inspection.

1.8.2. Inspection by the purchaser or his representatives, or failure of the purchaser or his representatives to

provide inspection, shall not relieve the contractor of his responsibility to furnish materials and to perform work in accordance with these specifications.

1.8.3. Material, fabricated parts and pipe which are discovered to be defective, or which do not conform to the requirements of these specifications, will be subject to rejection at any time prior to final acceptance of the pipe. Rejected material and pipe shall promptly be removed from the site of the work.

Sec. 2–1.9—Material and Workmanship

All material furnished by the contractor shall be new and of the quality specified. All work shall be done in a thorough, workmanlike manner by mechanics skilled in their various trades.

Sec. 2–1.10—Tests

1.10.1. The contractor shall furnish, in advance of the manufacture of steel cylinders and reinforcing cages, mill-test reports on each heat from which the steel is rolled, if required.

1.10.2. The contractor shall provide test specimens cut on the job from each shipment of steel for reinforcing and for cylinders, as directed by the engineer.

1.10.3. Each completed steel cylinder with joint rings welded to its ends shall be subjected to a hydrostatic test as specified herein under Sec. 2–3.5.4.

1.10.4. Frequent samples of the mixed concrete shall be taken for making up compression test cylinders as specified under Sec. 2–3.7.5.

1.10.5. If required by the engineer, the contractor shall submit test results showing the chemical and physical properties of rubber used in the gaskets.

1.10.6. The expense of the required mill tests of materials, and of testing the completed steel cylinders, shall be borne by the contractor. All other tests shall be made by representatives of the purchaser at the purchaser's expense, except as otherwise specifically provided.

Section 2–2—Material Specifications

Sec. 2–2.1—Cement

2.1.1. Cement for concrete work shall conform to the "Standard Specifications for Type I Portland Cement" (A.S.T.M. Designation C150–47), unless Type II cement is specified. Sampling and testing shall conform to the individual A.S.T.M. specifications designated therein.

2.1.2. Satisfactory facilities shall be provided for identifying, inspecting and sampling cement at the mill, the warehouse and the site of the work. The purchaser shall have the right to inspect the cement and obtain samples for testing at any of these points.

2.1.3. Cement shall be stored in a weathertight, dry, well ventilated structure approved by the engineer.

2.1.4. Cement salvaged by cleaning cement sacks, mechanically or otherwise, shall not be used in the work. Cement containing lumps will be rejected and shall immediately be removed from the site of the work.

2.1.5. If the temperature of the cement exceeds 150°F., it shall be stored until cooled to that temperature.

Sec. 2–2.2—Fine Aggregate

2.2.1. Fine aggregate for concrete and mortar shall consist of clean, hard,

durable and uncoated particles of natural sand or of sand prepared from the product obtained by crushing stone, gravel or other inert materials having similar qualities. The type of material shall be subject to the approval of the engineer. At the time of use the fine aggregate shall be entirely free of frozen material.

2.2.2. Fine aggregate shall be free from organic impurities to the extent that, when subjected to the color test for organic impurities, it shall produce a color in the sodium hydroxide solution not darker than that of Fig. 2 in the "Standard Method of Test for Organic Impurities in Sands for Concrete" (A.S.T.M. Designation C40–33).

TABLE 1

Gradation Requirements for Fine Aggregate

Sieve Size	Total Passing, by Weight *per cent*
⅜ in.	100
No. 4	95–100
No. 8	65–98
No. 16	45–80
No. 30	20–70
No. 50	5–50
No. 100	2–10
No. 200	0–5

2.2.3. Fine aggregate shall be of such quality that mortar composed of it, when tested by the "Standard Method of Test for Structural Strength of Fine Aggregate Using Constant Water-Cement Ratio Mortar" (A.S.T.M. Designation C87–44), shall have a compressive strength equal to that of similar specimens—of the same proportions and composed of the same cement and Ottawa sand—graded as specified in the "Method of Test for Compressive Strength of Hydraulic-Cement Mortars" (A.S.T.M. Designation C109–44).

2.2.4. Fine aggregate shall be well graded from coarse to fine and, when tested by means of laboratory sieves in accordance with the "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates" (A.S.T.M. Designation C136–39), shall conform to the gradation requirements in Table 1.

The gradation requirements given in Table 1 represent the extreme limits for determining the suitability of fine aggregate under these specifications. To maintain uniformity of gradation for aggregate from any given source, a fineness modulus determination shall be made upon representative samples from that source. Thereafter the fineness modulus of all shipments therefrom shall not vary more than ±0.20 from the fineness modulus of the representative sample.

Sec. 2–2.3—Coarse Aggregate

2.3.1. Coarse aggregate for concrete shall consist of hard, durable particles of crushed stone or crushed or uncrushed gravel conforming to the requirements and tests given in paragraphs 2.3.2 through 2.3.5.

2.3.2. Coarse aggregate shall be well graded from coarse to fine. The maximum size and gradation shall be subject to the approval of the engineer and shall be such that the concrete can be readily placed inside the cylinder, by the particular method used in placing it, to provide a solid, compact, homogeneous wall with a smooth surface. Tests for gradation of coarse aggregate shall be in accordance with the "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates" (A.S.T.M. Designation C136–39).

2.3.3. Deleterious substances in coarse aggregate shall not exceed the amounts given in Table 2, as deter-

mined by sampling and testing procedures listed in the "Standard Specifications for Concrete Aggregates" (A.S.T.M. Designation C33–44).

2.3.4. Thin and elongated pieces, the maximum dimension of which exceeds five times the minimum, shall not be in excess of 10 per cent of the coarse aggregate by weight.

2.3.5. The coarse aggregate, when subjected to five alternations of the sodium sulfate test in accordance with the "Tentative Method of Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate" (A.S.T.M. Designation C88–46T), shall have a corrected loss not in excess of 12 per cent, unless specifically permitted by the engineer.

TABLE 2

Permissible Amounts of Deleterious Substances in Coarse Aggregate

Material	Maximum Weight Limit *per cent*
Soft particles	4.00
Coal and lignite	0.50
Clay lumps	0.25
Material finer than 200 sieve	1.00
Combined total of above items	5.00

Sec. 2–2.4—Samples of Concrete Aggregates

At least four weeks prior to mixing concrete, the contractor, if required, shall deliver in suitable containers, for preliminary approval, samples of not less than 1 cu.ft. each of fine aggregate and coarse aggregate. All samples shall be plainly labeled to indicate the source of the material, the date and the name of the collector. Methods of sampling aggregates shall be in accordance with the "Tentative Methods of Sampling Stone, Slag Gravel, Sand and Stone Block for Use as Highway Materials" (A.S.T.M. Designation D75–46T).

Sec. 2–2.5—Water

Water used for concrete and for curing pipe shall be clean and free from oil, acid, strong alkalies or vegetable matter, and the source shall be approved by the engineer.

Sec. 2–2.6—Steel for Cylinders

Steel for cylinders shall conform to the "Tentative Specifications for Heavy Gage Structural Quality Flat Hot-Rolled Carbon Steel, Open-Hearth, Grade B" (A.S.T.M. Designation A245–48T), unless otherwise permitted. Where special operating conditions necessitate the use of sheets of higher tensile properties, sheets of special alloy steel may be used, subject to the approval of the engineer.

Sec. 2–2.7—Steel for Reinforcement

2.7.1. The wire for circumferential reinforcement shall be not less than $\frac{1}{8}$ in. in diameter and shall have high tensile characteristics. It shall be selected for applicability to the particular design conditions pertaining to the diameter and design pressure of the pipe. The type and size of wire shall be subject to the approval of the engineer and shall conform to one of the three following specifications: "Standard Specifications for Oil-Tempered Steel Spring Wire" (A.S.T.M. Designation A229–41); "Standard Specifications for Hard-Drawn Steel Spring Wire" (A.S.T.M. Designation A227–47T); or "Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement" (A.S.T.M. Designation A82–34).

2.7.2. Wire-mesh reinforcement for mortar coating for fittings shall conform to the "Standard Specifications for

Welding Steel Wire Fabric for Concrete Reinforcement" (A.S.T.M. Designation A185–37).

2.7.3. Steel wire reinforcement for concrete for fittings shall conform to "Standard Specifications for Billet-Steel Bars for Concrete Reinforcement, Structural Grade" (A.S.T.M. Designation A15–39).

Sec. 2–2.8—Steel for Joint Rings

2.8.1. Steel strips for bell rings less than ¼ in. thick shall conform to "Tentative Specifications for Hot-Rolled Strips of Structural Quality, Grade A" (A.S.T.M. Designation A303–47T).

2.8.2. Steel plate for bell rings ¼ in. or more in thickness shall conform to the "Tentative Specifications for Low and Intermediate Tensile Strength Carbon-Steel Plates of Structural Quality, Grade A" (A.S.T.M. Designation A283–46T).

2.8.3. Special shapes for spigot joint rings shall conform to the "Standard Specifications for Boiler Rivet Steel and Rivets, Grade A" (A.S.T.M Designation A31–40), except that paragraph 7(b) shall be waived, or to the "Tentative Specifications for Low and Intermediate Tensile Strength Carbon-Steel Plates of Structural Quality, Grade A" (A.S.T.M. Designation A283–46T).

Sec. 2–2.9—Steel Castings for Fittings

Steel castings for fittings shall conform to the "Tentative Specifications for Mild- to Medium-Strength Carbon-Steel Castings for General Application, Grade 70–36, Normalized" (A.S.T.M. Designation A27–46T).

Sec. 2–2.10—Steel Plates for Specials and Fittings

Steel plates for specials and fittings shall conform to the "Tentative Specifications for Low and Intermediate Tensile Strength Carbon-Steel Plates of Structural Quality, Grade B or C" (A.S.T.M. Designation A283–46T).

Section 2–3—Fabrication of Pipe

Sec. 2–3.1—General Requirements

3.1.1. In general, pipe shall have a minimum nominal length of 16 ft.; except for bends, reducers, closure pieces and other special fittings which may be made in shorter lengths.

3.1.2. Pipe shall be round and true and shall have smooth and dense finished surfaces. The mean internal diameter of any portion of each section of pipe shall not fall short of the nominal diameter or size specified by more than ¼ in.

3.1.3. The thickness of the core, which shall include the steel cylinder, and the minimum thickness of the coating for each size of pipe shall be as shown in Table 3. A tolerance of ± ⅛ in. will be permitted in core thickness.

Sec. 2–3.2—Design of Steel Reinforcement

The reinforcement of the pipe shall consist of a welded steel cylinder with high-tensile-strength wire wrapped around it under tension after the concrete lining has been placed and cured. The cylinder shall have a thickness not less than 16 gage, U.S. Standard, and shall be of approved thickness. The thickness of the steel cylinder, the size of the high-tensile wire and the spacing and tension under which it is wound shall be such that the steel cylinder and wire shall reach their respective

elastic limits simultaneously at a pressure equivalent to at least 2¼ times the normal water pressure for which the pipe is designed. The steel wire reinforcement and its application shall be such that it will compress the core sufficiently to prevent any tensile stress in the core at the design working pressure. The maximum centerline spacing of the wire shall not exceed 1 in. and the minimum shall be 0.3 in. The contractor shall submit calculations for the determination of details of the pipe reinforcement prior to the manufacture of any pipe, if such calculations are required by the engineer.

TABLE 3

Core Thickness and Minimum Coating Thickness

Pipe id.	Core Thickness (Including Cylinder)	Min. Coating Thickness	
		Mortar	Concrete
	in.		
16	1	¾	1
20	1¼	¾	1
24	1½	¾	1
30	1⅞	¾	1
36	2¼	¾	1
42	2⅝	¾	1
48	3	¾	1

Sec. 2–3.3—Joint Rings

The steel bell-and-spigot joint rings shall be so designed and fabricated that when the pipe is laid it will be self-centering. The rings shall be accurately formed and finished to obtain a close, sliding fit for the self-centering surfaces. The tolerance between the theoretical diameters and the actual diameters of the contact surfaces shall be such that the clearance shall not exceed $\frac{1}{32}$ in. Each ring shall be formed by one or more pieces of steel butt-welded together, either by a resistance welder or by a hand electric-arc weld. After welding, the rings shall be smoothed by grinding the rough surfaces of the weld flush with the adjacent surface. The rings shall be expanded by a press beyond their elastic limits so that they are accurately shaped. They shall be checked for size and shape on accurate templates before being welded to the cylinders. The minimum thickness of the completed bell or spigot rings shall be $\frac{3}{16}$ in. The rings shall conform to the details submitted by the manufacturer and approved by the engineer. The joint rings shall be so designed that, when the pipe is laid and the joint completed, the gasket will be enclosed on all four sides. The contact surfaces shall be smooth, to prevent cutting of the rubber gasket during installation. The portions of the joint rings which will be exposed after the pipe is cast shall be protected from corrosion by a metallic coating with a minimum thickness of 0.002 in., applied by an approved method. When specifically permitted, an approved nonmetallic coating may be used.

Sec. 2–3.4—Rubber Gaskets

3.4.1. The joint shall be sealed with a continuous ring gasket made of a special composition rubber of such size and cross section as to fill completely the recess provided for it. The gasket shall be the sole element depended upon to make the joint watertight and shall have smooth surfaces free from pitting, blisters, porosity and other imperfections. The rubber compound shall contain not less than 65 per cent by volume of first-grade natural crude rubber. The remainder of the compound shall consist of pulverized fillers free from rubber substitutes, reclaimed rubber

and deleterious substances. The compound shall meet the following physical requirements when tested in accordance with appropriate sections of "Methods of Physical Tests and Chemical Analyses for Rubber Goods" (Federal Specification ZZ–R–601 and 601A):

Tensile strength. The tensile strength of the compound shall be at least 2,700 psi.

Elongation at rupture. Two-inch gage marks shall stretch to not less than 10 in. at rupture.

Specific gravity. The specific gravity shall be between 1.15 and 1.23.

Cold flow test. The percentage of cold flow—computed as 100 times the change in thickness divided by the original thickness—shall not exceed 12 when tested by subjecting a disk of the material, $\frac{1}{4}$ in. thick by $\frac{3}{4}$ in. in diameter, to a pressure of 600 psi., using a spring pressure device placed in an air oven at a temperature of 158°F. for 24 hours.

Tensile strength after aging. The tensile strength of the compound, after being subjected to an accelerated aging test for 96 hours in air at 158°F., shall not be less than 80 per cent of the tensile strength before aging. The test shall be that described in "Methods for Testing Rubber Goods" (Federal Specification ZZ–R–601–A, Sec. 2, Par. 14).

3.4.2. The contractor shall submit for approval details of the shape and size of the gaskets he proposes to furnish. If required by the engineer, the contractor shall also submit test results showing the chemical and physical properties of the materials used in the manufacture of the gaskets.

Sec. 2–3.5—Fabrication of Steel Cylinders

3.5.1. The cylinders shall be formed by shaping and welding together steel sheets of specified material and thickness. The cylinders shall be accurately shaped to the size required, and the joint rings shall be welded to the ends before testing.

3.5.2. The manufacturer may use either lap welding or butt welding for all longitudinal and circumferential welds. All welds shall be made downhand by the manual or automatic shielded-arc process. Welding shall be done so that there shall be thorough fusion and complete penetration. Prior to welding, the sheets shall be fitted closely and during welding shall be held firmly together. The manufacturer shall submit for approval, if required, the specific details of materials and methods he proposes to use before any welding is done.

3.5.3. Specimens for tensile and bending tests of welds shall be furnished by the contractor to the engineer as required. The number of cylinders from which test specimens are required to be cut shall not exceed one in every 3,000 ft. of pipe; provided that, if tests indicate the welding is unsatisfactory, the contractor shall furnish additional samples as required by the engineer. Cylinders from which test specimens have been cut may be patch-welded in an approved manner and used in the work The test specimens, procedure and results shall conform to the requirements of the "Reduced Section Tensile Test" and the "Free Bend Test" described in Sec. 3–5.1, 3–5.2 and 3–5.3 of "Standard Specifications for Electric Fusion Welded Steel Water Pipe of Sizes 30 Inches and Over" (A.W.W.A. 7A.3–1940). The expense of the welding tests shall be borne by the purchaser.

3.5.4. Each steel cylinder, with joint rings welded to its ends, shall be subjected to a hydrostatic test under a

water pressure which stresses the steel to a unit stress of at least 20,000 psi. but not greater than 25,000 psi. While under pressure test, all welds shall be thoroughly inspected and all parts showing leakage shall be marked. Cylinders which show any leakage under test shall be rewelded at the points of leakage and subjected to another hydrostatic test. The finished cylinder, with joint rings attached, shall not be used in the work unless it is completely watertight under the required test pressure.

Sec. 2–3.6—Placing of Wire Reinforcement

The high-tensile wire shall not be wound around the cylinder until at least seven days after the concrete lining is placed, unless otherwise specifically permitted, and until the concrete has reached the minimum seven-day compressive strength specified under Sec. 2–3.7.8 of this document. The net compression induced in the concrete lining of the core shall not exceed 40 per cent of the compressive strength of the concrete at the time of wrapping. Methods and equipment for applying the wire shall be such that it will be wrapped around the cylinder in a helical form at the designed predetermined spacing and tension for the full length of the cylinder. At the ends of the pipe, the wire shall continue for one extra circumferential lap. Methods for fastening the wire at the ends of the cylinder and for splicing wires shall be such that the connections will develop a strength equivalent to the strength of the wire.

Sec. 2–3.7—Concrete for Pipe Lining

3.7.1. *General.* The concrete lining of the steel cylinder may be placed by the centrifugal method, by the vertically cast method or by other approved methods.

3.7.2. *Proportioning.* The proportions of cement, fine aggregate, coarse aggregate and water used in concrete for pipe cores shall be subject to the approval of the engineer. The proportions shall be determined and controlled as the work proceeds, to obtain homogeneous, dense, workable, durable concrete of specified strength in the walls of the pipe and a minimum of defects in the surface of the pipe. The proportions shall be those which will give the best overall results with the particular materials and method of placing used for the work. A minimum of 7.0 bags of cement shall be used for each cubic yard of concrete. The water-cement ratio shall be such as to assure that the concrete will meet the strength requirements.

3.7.3. *Measurement of materials.* A barrel of cement shall be considered as 4 cu.ft. or 376 lb., and a bag of cement shall be considered as 1 cu.ft. or 94 lb. Cement in standard sacks need not be weighed, but bulk cement shall be weighed. Water for mixing shall be measured by volume or by weight. Concrete aggregates for each batch shall be measured separately by weighing. The proportions of aggregates shall be computed on the saturated and surface-dry basis and the water-cement ratio shall be exclusive of water within the aggregates and absorbed by them. The equivalent unit weights for both fine and coarse aggregates shall be determined in accordance with the "Standard Method of Test for Unit Weight of Aggregate" (A.S.T.M. C29–42), using a 1-cu.ft. cylindrical container. The equipment and devices for weighing and measuring shall at all times be accurate within 1 per cent.

3.7.4. *Mixing.* The mixing shall be thoroughly done by a batch mixer of approved type, rotating at a speed of 14–20 rpm. or a peripheral speed of approximately 200 fpm. The drum shall be entirely emptied before recharging. Mixing time shall be at least three minutes. Transit mixing shall not be used except by written authorization and under specific requirement of the engineer.

3.7.5. *Standard test cylinders.* A set of at least four standard test cylinders shall be taken from each day's pour of the mixed concrete for pipe cores made by either the centrifugal method, the vertically cast method or by other approved methods. Standard test cylinders shall be made and stored in conformance with the "Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field" (A.S.T.M. Designation C31–44). The curing of the test cylinders shall be in conformity with the curing of the pipe cores.

3.7.6. *Centrifugal test cylinders.* If the centrifugal method is used for making pipe cores, additional sets of four test cylinders of approved size and type shall be made by the centrifugal process at the beginning of the work and at intervals during the manufacture of the pipe. The number shall not exceed one set for each 400 lengths of pipe. Centrifugal cylinders shall be made by attaching to the spinning mold or frame a test cylinder mold and placing the concrete within it by spinning at the same speed and for the same interval employed in the manufacture of the pipe. The concrete shall be spun in the centrifugal test molds in approximately 2-in. layers. The test cylinders shall be tested at the expense of the purchaser in an approved testing laboratory at 7, 14 and 28 days to establish and check ratios of strength of the two types of cylinders. Upon determination of this ratio, the strength of the concrete core shall be determined by application of the ratio of strengths obtained for the two types of test cylinders.

3.7.7. *Testing cylinders.* All test cylinders shall be tested by an approved testing laboratory at the expense of the purchaser, unless the manufacturer has approved testing facilities at the site of the work. In such event, tests may be made by the manufacturer in the presence of the engineer or, if permitted by the engineer, certified test reports may be submitted by the manufacturer.

3.7.8. *Strength of concrete.* Standard concrete cylinders shall attain a compressive strength of not less than 2,600 psi. in 7 days and 4,500 psi. in 28 days. Centrifugal test cylinders shall attain a compressive strength of not less than 3,500 psi. in 7 days and 6,000 psi. in 28 days. Pipe made from concrete which does not meet the strength tests will be subject to rejection.

3.7.9. *Placing concrete by centrifugal method.* The steel pipe cylinder with joint rings attached shall be held securely by spinning frames so constructed that the cylinder will be kept truly circular. The frames shall be placed horizontally in a spinning machine capable of revolving them at speeds up to at least 3,200 fpm. The method of placing concrete in the cylinder and the speed of rotation during placing shall be such that the concrete will be evenly distributed and well compacted at the specified thickness throughout the length of the pipe. After the concrete has been deposited, the rotation shall be continued at a speed and for a length of time sufficient to provide the specified strength and suffi-

cient compaction and bond to permit removal from the spinning machine without injury to the pipe core. Excess water and laitance shall be removed from the interior surface of the pipe in an approved manner so that the surface shall be solid, straight and true. If necessary to provide a smooth surface, the interior shall be honed after curing.

3.7.10. *Placing concrete by vertically cast method.* The concrete lining or core shall be cast on end on a cast-iron or steel base ring with the cylinder used for the exterior form and a rigid steel collapsible form for the interior. The interior form shall be so designed that it will have a smooth contact surface and tight joints and will be firmly and accurately held in proper position without distortion during the placing of the concrete. The forms shall be provided with top and bottom stiffening rings and shall be designed to permit removal without injury to the inside surface of the pipe. The forms shall be thoroughly cleaned and oiled before each period of use. The transporting and placing of concrete shall be carried out by approved methods which will prevent the separation of concrete materials and the displacement of the steel cylinder or form from its proper position. Approved methods of mechanical vibrating and rodding shall be used to compact the concrete in the forms and to secure satisfactory interior surfaces. Forms shall not be removed until the concrete has set sufficiently to avoid spalling or damage to the pipe during the process of form removal.

3.7.11. *Other methods of placing the lining.* If the contractor proposes to employ a method other than the centrifugal or vertically cast methods for placing the concrete lining or core within the cylinder, he shall submit for approval complete details of the methods and equipment he proposes to use.

Sec. 2–3.8—Curing of Pipe Lining

3.8.1. *General.* The lined cylinders shall be cured by steam, by water or by the use of approved curing compounds. Steam shall be used for curing unless the temperature in the curing chamber is continuously above 50°F. and unless the water or curing compound method is specifically permitted. Adequate space and facilities shall be provided for proper curing.

3.8.2. *Steam curing.* The lined cylinders shall be placed in the steam curing chamber, and, as soon as the chamber is filled and the concrete has hardened sufficiently, the cylinders shall be kept in contact with moist steam at a temperature of at least 110°F. and not more than 150°F. for a period of at least 36 hours. Curing by steam shall be continuous, except during a period sufficient to remove the inner form or supporting rings. The form shall not be removed until at least twelve hours after the beginning of curing.

3.8.3. *Water curing.* The lined cylinders shall be kept moist by water spraying for a period of at least 36 hours. Following this minimum period, they may be "tipped" from their bases and removed to the storage yard, where they shall be kept continuously moist by intermittent spraying for a period of at least three days.

3.8.4. *Curing compounds.* An approved type of curing compound may be used for curing the cylinder linings, if specifically permitted. The compound shall be applied as soon as the forms are removed (for vertically cast cores) and as soon as the concrete is sufficiently hard (for centrifugally cast

cores), and at such time as to retain sufficient moisture for adequate curing.

Sec. 2–3.9—Pipe Coating

3.9.1. *General.* After the lined cylinder has been wrapped with high tensile wire, an exterior mortar or concrete coating shall be applied.

3.9.2. *Mortar coating.* Mortar for coating shall consist of 1 part cement to not more than 3 parts of fine aggregate. Cement and fine aggregate shall conform to Sec. 2–2.1 and 2–2.2 herein. The mortar shall be thoroughly mixed, and, after mixing is completed, it shall be deposited under impact or vibration by an approved method so that a dense, durable coating of a minimum thickness of $\frac{3}{4}$ in. will be obtained.

3.9.3. *Concrete coating.* Concrete for coating shall be of an approved mix. It shall consist of 1 part cement to not more than 4 parts of aggregates. The fine and coarse aggregates and cement shall meet the requirements of Sec. 2–2.1, 2–2.2 and 2–2.3 of this document, except that the grading of coarse aggregate shall be such that it will all pass a $\frac{1}{2}$-in. laboratory sieve. The concrete shall be placed and compacted by approved methods and equipment so that a dense, durable coating of a minimum thickness of 1 in. will be obtained.

3.9.4. *Strength.* The coating shall develop a 7-day compressive strength of at least 2,600 psi. and a 28-day compressive strength of at least 4,500 psi. when sampled and tested by the standard method specified in Sec. 2–3.7.7 herein.

Sec. 2–3.10—Curing of Coating

3.10.1. *General.* The coating outside the cylinder shall be cured by steam, by water or by the use of approved curing compounds. Adequate space and facilities shall be provided for proper curing.

3.10.2. *Steam curing.* The coated pipe shall be placed in the curing chamber as soon as practicable after placing the coating and shall be steam-cured as specified under Sec. 2–3.8.2. for a period of at least twelve hours. The pipe shall be handled in such a manner as to avoid injury to the coating during transportation to and from the curing chamber.

3.10.3. *Water curing.* As soon as the coating has set sufficiently, it shall be kept moist by continuous water spraying or by intermittent spraying and burlap and canvas covering for a period of at least four days.

3.10.4. *Curing compounds.* If specifically permitted, approved curing compounds may be used to cure the coating. They shall be applied as soon as the coating is sufficiently hard to prevent damage to it and while the coating still retains sufficient moisture for adequate curing.

Section 2–4—Specials and Fittings

Sec. 2–4.1—General

The manufacturer shall furnish all fittings and special pieces required for closures, curves, bends, branches, manholes, air valves, blowoffs and connections to main-line valves and other pipes shown on the contract drawings or ordered by the purchaser. Specials shall conform to the details furnished by the purchaser, or, if required, to the details furnished by the manufacturer and approved by the purchaser. Either of two types shall be used:

Type A—specials with steel-sheet cylinder, concrete or mortar lining and

reinforced concrete or mortar exterior covering;

Type B—specials of cut and welded steel plate of approved thickness, with mortar coating on interior and exterior.

Sec. 2–4.2—Specials (Type A)

The steel sheet shall be cut, shaped and welded to form the properly shaped bend, tee, reducer or other special. The welds shall be inspected and the completed cylinder shall be tested for tightness by an approved method, if specifically required by the purchaser. A cage or cages of steel reinforcement with approved cross-sectional areas shall be formed around the cylinder and openings. Longitudinal reinforcement sufficient for the additional stresses in the pipe walls shall be provided. The interior and exterior concrete or mortar shall be placed in an approved manner.

Sec. 2–4.3—Specials (Type B)

4.3.1. The steel plate for the fabricated steel plate specials shall be cut, shaped and welded so that the finished special shall have the required shape and interior dimensions. The deflection angle between adjacent segments of a bend shall be not greater than 22½ deg. Adjacent segments shall be joined by butt welding. The minimum length of the courses shall be one-half the diameter of the pipe. Fabrication and welding shall conform to the requirements of Sec. 2–3.5 of these specifications and to such additional requirements for welding steel plate as the purchaser specifically stipulates.

4.3.2. Wire mesh reinforcing shall be applied to the interior and exterior surfaces of the fabricated special. It shall be 2 × 4-in. No. 13 gage welded wire fabric, held ¾ in. from the surfaces of the steel plate. The members on the 2-in. spacing shall extend circumferentially around the special with ends overlapped 4 in. and tied together. Longitudinal splices shall be staggered.

4.3.3. The steel plate specials shall be lined and coated with mortar at least ¾ in. thick, deposited on the surfaces by approved means. The mortar shall contain not less than 1 part cement to 3 parts sand, of a grading approved for the method of application used, and shall develop a 7-day compressive strength of not less than 2,600 psi. and a 28-day compressive strength of not less than 4,500 psi.

4.3.4. The mortar-coated specials shall be cured by water spraying, by steam or by curing compounds as specified under Sec. 2–3.10 herein.

Sec. 2–4.4—Curves, Bends and Closures

Horizontal and vertical long-radius curves shall be formed by straight pipe in which spigot rings are placed on a bevel. The total angular deflection for beveled pipe shall not exceed 5 deg. at any joint. Slight deflections may be made with straight or beveled pipe, provided that the maximum joint opening caused by such deflections shall not exceed ¾ in. for 16–36-in. pipe and 1 in. for 42- and 48-in. pipe. Short-radius curves and closures shall be formed by fabricated specials of either of the two types specified above.

Sec. 2–4.5—Openings and Connections

Manholes and flanged, spigot or bell connections for air valves, blowoffs or connections to other pipes shall be built into the walls of the concrete pipe at locations shown on the contract drawings or ordered by the purchaser. If required, the interior and exterior surfaces of structural steel connections

shall be lined and coated with reinforced mortar as specified in Sec. 2–4.3 of these specifications. Wall openings shall be formed by welding a saddle plate of approved thickness completely around the steel cylinder. The high-tensile wire shall be securely fastened upon each end of the saddle plate. The casting shall be welded to the saddle plate after the hole is cut through the plate, cylinder and inside concrete. Mortar or concrete coating reinforced with welded steel fabric shall be placed on the exterior of the saddle plate and around the neck of the fitting in an approved manner.

1949 Conference—Chicago

FOR the third year in a row, a new registration record was set when 1,967 A.W.W.A. members and guests, 263 more than last year, gathered at Chicago's Stevens Hotel for their 69th annual conference last May 30–June 3. And for the third year in a row, A.W.W.A. membership passed another goal in its record growth, this time topping the 7,500 mark with 47 to spare. Record-breaking, too, as much in enthusiasm as in number, were the crowds that jammed their way into technical sessions, exhibits and entertainment functions to take full advantage of the combination of business and pleasure which featured the five-day program.

Back in Chicago again after seven years, this year with more than 500 additional registrants, A.W.W.A. conventioners received a royal welcome, and if the holiday on which the conference opened was not called on their account, the city's Memorial Day celebration certainly added to the festive atmosphere. Moreover, the city was ready this time to display its "World's Largest Filtration Plant," a feature which most delegates made sure to inspect. And against this background the various committees, local and national, constructed and operated a program guaranteed to produce just the right mixture of interest, information and amusement.

Supervising the affair as a whole, again, was Bill Orchard's Convention Management Committee, serving on which were:

Representing A.W.W.A.	*Representing W.&S.W.M.A.*
W. W. DeBerard	C. N. Brown
H. R. Frye	E. E. Alt

Ex Officio

L. H. Enslow, *President*	W. F. Rockwell, *President*
H. E. Jordan, *Secretary*	A. T. Clark, *Secy.-Mgr.*
C. H. Capen, *Chm., Publications Com.*	

And although Bill, himself, was under the weather during convention week, his masterful planning and organization of the overall program was in great part responsible for its success.

On the technical side, it was a committee under Charlie Capen which devised a fourteen-session combination of a dozen panel discussions and more than twice that number of formal presentations, in which more than 100 scheduled speakers and at least as many more contributors participated. And if A. P. Black's fluoridation report, K. F. Maxcy's discussion of poliomyelitis, and the panels on water works ethics and water quality attracted the most attention, the others were not far behind and certainly no less important. The full technical program is reproduced on pages 1134–1136, and the prepared material has been and will continue to be recorded in the pages of the Journal, yet a great deal of the value of the program was, of course, represented by the spontaneous discussion, which,

1949 CONFERENCE STATISTICS

Chicago Registration by Days

Day	Men	Ladies	Total
Sunday, May 29	628	210	838
Monday, May 30	584	141	725
Tuesday, May 31	231	20	251
Wednesday, June 1	96	3	99
Thursday, June 2	54		54
TOTALS	**1,593**	**374**	**1,967**

Geographical Distribution of Registrants

UNITED STATES and TERRITORIES					
Alabama	28	Maryland	24	Tennessee	47
Alaska	1	Massachusetts	23	Texas	35
Arizona	1	Michigan	66	Utah	1
Arkansas	9	Minnesota	36	Virginia	23
California	77	Mississippi	10	Washington	10
Colorado	15	Missouri	93	West Virginia	10
Connecticut	4	Nebraska	12	Wisconsin	103
Delaware	3	New Hampshire	2	Wyoming	2
Dist. Columbia	15	New Jersey	90	**CANADA, CUBA and FOREIGN**	
Florida	31	New York	175	Australia	1
Georgia	22	North Carolina	13	Canada	39
Hawaii	4	North Dakota	7	Cuba	6
Illinois	402	Ohio	100	Egypt	1
Indiana	71	Oklahoma	22	Great Britain	3
Iowa	65	Oregon	2	Indonesia	1
Kansas	20	Pennsylvania	140	Mexico	6
Kentucky	29	Puerto Rico	2	Venezuela	3
Louisiana	24	Rhode Island	13	**TOTAL**	**1,967**
Maine	5	South Carolina	13		
		South Dakota	6		

Comparative Registration Totals—1940–1949

Year	Place	Men	Ladies	Total
1949	Chicago	1,593	374	1,967
1948	Atlantic City	1,348	356	1,704
1947	San Francisco	1,115	431	1,546
1946	St. Louis	1,303	214	1,517
1944	Milwaukee	1,185	171	1,356
1943	Cleveland	973	158	1,131
1942	Chicago	1,198	240	1,438
1941	Toronto	1,136	309	1,445
1940	Kansas City	1,265	202	1,467

Winners of Section Awards—1949

Henshaw Cup	**Hill Cup**	**Old Oaken Bucket**
Cuban 88.9%	**Southwest .... 45.6 pt.**	**California 798**

unfortunately, could not be preserved, except in the memory of those who participated.

On another aspect of the information front, Art Clark and his Exhibit Committee pushed ahead with some 130 boothsful of the newest and best in water works equipment and material, three booths of the oldest and rarest, and one booth of the best in Florida orange juice, celebrating the election of Florida's own A.W.W.A. President. With 84 exhibitors spreading their wares in some 13,320 sq.ft. of the Stevens Exhibit Hall, members had an unparalleled chance to stop, shop and shop-talk.

As for entertainment, Tom Quigley's General Entertainment Committee went all out to give everyone a good time. Beginning with the Memorial Day President's Reception and Dance, through the new award night and its concert, the informal Hayseed Hullabaloo, and closing with the Annual Dinner and Dance, attendance and, even more important, enthusiasm hit new highs. Featured by a return toward self-sufficiency in entertainment, the program was the best received in years.

With his job getting bigger each year, "Sig" Sigworth, as usual, grew with it and saw that everyone got there and got away with a minimum of difficulty. And during the stay, it was, of course, the Illinois Section, under Carl Brown's Local Arrangements Committee and Mrs. L. E. Harper's Ladies Entertainment Committee with hosts of helpers and helpers of hosts, which saw to it that members were happy. As a matter of fact, every passing and progressing year accentuates more definitely the importance of local section cooperation, and the very success of each conference must in itself acknowledge the good work done by literally hundreds of local section members and their wives.

Association Awards

Honorary Membership was conferred upon Thomas L. Amiss, of Shreveport, La.; Henry Berry, of London, England; and M'Kean Maffitt, of Wilmington, N.C. The citations follow:

THOMAS L. AMISS, Superintendent and Engineer, Department of Water and Sewerage, Shreveport, La.; a member of the Association since 1918; Director, representing the Southwest Section, 1942–45; Fuller Award 1945; *a water works executive of high merit who has received the support of his fellow citizens over a long span of years.*

HENRY BERRY, Past-Chairman, Metropolitan Water Board, London, England; a member of the Association since 1944; President, British Waterworks Association, 1948–49; Member of Parliament; *an inspiring leader of an essential civilian activity in wartime; a useful servant of his people in time of peace.*

M'KEAN MAFFITT, Former Superintendent of Water and Sewerage, Wilmington, N.C. (now retired); a member of the Association since 1922; Fuller Award 1947; *long devoted to the advancement of the water works industry and water works men in his state, using as a medium the North Carolina Section, of which he was an organizer, a driving force and a membership builder.*

The John M. Diven Medal, awarded to the member whose services to the water works field during the past year are deemed most outstanding, was presented to Harry A. Faber. The citation follows:

HARRY A. FABER, for his untiring efforts to further the understanding of chlorination technology among men responsible for the treatment of public water supplies.

The John M. Goodell Award, granted for the best paper published in the JOURNAL, was presented to Laurie M. Leedom. The citation follows:

LAURIE M. LEEDOM, for his paper entitled "Shutdown Procedure in Main Breaks," as published in the April 1948 JOURNAL (Vol. 40, page 393); the paper being timely and highly valuable because of its constructively planned procedure for the restoration of service after a water main break.

The George Warren Fuller Awards were presented to twenty-three men whose Sections had honored them during 1948 and 1949—the period from the 1948 Atlantic City Conference up to the beginning of the 1949 Chicago Conference—"for their distinguished service in the water supply field and in commemoration of the sound engineering skill . . . the brilliant diplomatic talent . . . and the constructive leadership of men . . . which characterized the life of George Warren Fuller." The list of awardees follows:

Alabama-Mississippi Section—ARTHUR NEWELL BECK: For outstanding service in the organization of the Alabama-Mississippi Section of the American Water Works Association; the Alabama Water and Sewage Association; and his general contributions to water works activities.

California Section—LOUIS JESSUP ALEXANDER: For his unflagging interest in the Association and the Section; and especially for his splendid, outstanding and valuable work as Chairman of the Water Supply Standards Committee.

Canadian Section—JOHN CLARK KEITH: For outstanding administration and engineering service in the water works field; for long and constructive interest in Association affairs; and for his service to other engineering and professional associations in Canada.

Chesapeake Section—HARRY RUTLEDGE HALL: In recognition of his advancement of the water works profession through his continuous activity in this Association; and for his effective service in the sanitary engineering field, especially as Chief Engineer of the Washington Suburban Sanitary District.

Illinois Section—HAROLD EATON BABBITT: In recognition of his many years of distinguished service to the water supply field, in training students in sanitary engineering, and his active assistance in the operation of the yearly short courses for water plant operators.

Indiana Section—LEWIS SPANN FINCH: In recognition of his persistent and faithful devotion in developing, teaching and applying sound and ethical practices in the water works field; and for his unselfish inspiration to his fellow members.

Iowa Section—DALE LEROY MAFFITT: For his indefatigable and effective effort to tell the water works story; because he is an inspiring example of dignity, unselfishness, industry and accomplishments to the Section, the Association, his profession and his community.

Kansas Section—WALTER ORTEN MYERS: In recognition of his managerial ability; his promotion of good health and sanitation practices; and his furtherance of research in the fluoridation of public water supplies.

Kentucky-Tennessee Section—ALBERT FREDERICK PORZELIUS: For active participation in affairs of the Section; for outstanding service as manager of a public water supply organization; and for the establishment and maintenance of excellent public relations during a difficult period.

Michigan Section—JOHN MERRILL HEPLER: For his encouragement and assistance to water works operators of Michigan and for his work in the development of water treatment processes.

Minnesota Section—LEONARD NEWTON THOMPSON: For his devotion and earnest, unselfish efforts in promoting better water works practices throughout his thirty years of service in the water works profession; and for his efficient management of the St. Paul Water Department.

Missouri Section—MELVIN PROSS HATCHER: In recognition of his business-like administration of a revitalized water department; his perseverance in bettering the public relations of his department; and for his contributions to the development and application of equitable rates for water service.

New England Section—EDWARD SHERMAN CHASE: In recognition of his outstanding contributions to and leadership in water works engineering; for his service in the organization of the New England Section; and for his continuing interest therein.

New Jersey Section—ROSWELL MORTON ROPER: For his outstanding contributions to water works practice through his successful management for many years of an important water supply system; for his notable work in water conservation; and for his active support of the New Jersey Section.

New York Section—SIMON PETER CARMAN: For his many years of conscientious and constructive leadership in assembling and directing panel discussions of vital interest to the Section and the Association.

North Carolina Section—DANIEL MCGREGOR WILLIAMS: For his untiring services to the Section as Trustee, Secretary, Chairman and Director; and for his help in promotion of, and active participation in, the Water Works School for Plant Operators.

Ohio Section—FREDERICK HOLMAN WARING: For his successful conduct of his duties, overcoming difficulties through sustained effort and constructive foresight; and for his consistent interest in the affairs of water works men.

Pacific Northwest Section (1948)—WILLIAM CHESTER MORSE: For pre-eminence in the field of hydraulic engineering; a leader in the water works profession in the Pacific Northwest; a capable administrator who inspires confidence within his profession and among those whom he serves.

Pacific Northwest Section (1949)—ROBERT ALEXANDER DUFF: In recognition of his devotion to the water works profession as exemplified by his management of the Medford Water System; and for his many contributions to the Pacific Northwest Section of the Association.

Pennsylvania Section—LORENZ STEWART MORGAN: In recognition of the time and energy so unstintingly given in furthering the interests of the Association; for his advancement of water works practices through sound engineering judgment; and for his generous assistance to operators of small water works.

Southeastern Section—FRANCIS BUCK MCDOWELL JR.: For his outstanding accomplishments in the development of a modern public water system for Charles-

ton, South Carolina; and for his ability to investigate, evaluate and adopt boldly new methods of water procurement, transmission and treatment.

Southwest Section—MORRISON BENJAMIN CUNNINGHAM: For his exemplary management of the Oklahoma City Water Department; for his advancement of water works operation and management through his many talks and articles; and for his loyal support of the Association and his Section in all of their activities.

Virginia Section—WELLFORD HOPE SHEWBRIDGE: For his outstanding service as Secretary of the Section; and for his efficient handling of the many assignments given him, all of which have contributed greatly to the success of the Virginia Section.

The Nicholas S. Hill Jr. Cup, awarded annually to the Section making the largest weighted gain in membership, was presented to the Southwest Section, which had a score of 45.6.

The Henshaw Cup, awarded annually to the Section having the greatest percentage of its members present at the Section's annual meeting, was won by the Cuban Section with a score of 88.9 per cent.

The Old Oaken Bucket, for the tenth year in succession, went to the California Section as the largest Section in the Association.

Schedule of Conference Papers and Reports

Water Works Management Division—9:30 A.M.—May 30, 1949

Panel Discussion—Effects of State Highway Construction Policies.....L. W. Grayson, W. G. Banks and A. C. King
Making Municipal Reports Interesting.....E. B. Mayer
Panel Discussion—Types of Insurance Protection for Municipal Water Departments..... C. G. Bourgin, R. O. Ellis and E. C. Schwier

Water Purification Division—9:30 A.M.—May 30, 1949

Taste and Odor Control in Water Treatment Plants at the Lower End of Lake Michigan.... Leo Besozzi and J. C. Vaughn
Highlights of the Operation of the New Chicago Filters.....J. R. Baylis
The Operation and Design of Small Water Works.....M. E. Flentje and I. M. Glace
Discussions.....E. M. Craig, A. B. Daugherty, E. R. Dougherty, H. L. Keinath and W. H. Willsmann

General Session—2:00 P.M.—May 30, 1949

Water Department Operations Under City Manager Administration.....G. E. Arnold
Discussion.....Reeves Newsom
Water Supply Problems in the Chicago Metropolitan Area.....L. D. Gayton
Committee Report—Installing Cast-Iron Water Mains.....J. P. Schwada, *Chairman*
Experiences With Cement as a Jointing Material.....D. L. Maffitt
Discussions.....L. E. Goit, G. W. Pracy and C. F. Wertz

Water Resources Division—9:30 A.M.—May 31, 1949

Open Forum—Ground Water Law—Current Developments.....C. H. Bechert, R. J. Bernhagen, H. T. Critchlow, A. H. Johnson, G. S. Knapp, J. C. Thompson and L. F. Warrick

Committee on Water Works Administration—9:30 A.M.—May 31, 1949

Preliminary Committee Report—Compensation of Water Works Personnel.....
L. A. Smith, *Chairman*
Other Water Works Administration Committee Reports.....

Water Works Management Division—2:00 P.M.—May 31, 1949

Committee Report—Regulation of Water Use for Air Conditioning.....
F. C. Amsbary, *Chairman*
Committee Report—Water Main Extension Policy.....L. S. Finch, *Chairman*
Panel Discussion—Diversion of Water Department Reserve Funds.....*Led by* W. R. LaDue, E. A. Bell, A. R. Davis, J. C. Detweiler, D. D. Gross, C. M. McCord and W. C. Morse

Water Purification Division—2:00 P.M.—May 31, 1949

Symposium—Processing Water for Industry:
Rayon.....R. W. Haywood Jr.
Soft Drinks.....B. H. Wells
Panel Discussion—Bacterial Reproduction in Zeolite Layers.....*Led by* W. W. Aultman, George H. Klumb, H. C. Marks and Carl Wilson
Symposium—Influence of Synthetic Detergent Pollution on Water Coagulation.....
J. T. Cross, W. U. Gallaher, J. W. Hassler and Lindsay Hobbs

General Session—9:30 A.M.—June 1, 1949

Panel Discussion—Ethics of the Water Works Industry.....S. B. Morris, Malcolm Pirnie and W. F. Rockwell
The British Water Industry.....N. F. S. Winter
Wisconsin Policies Concerning Water Department Funds.....Timothy Brown

General Session—2:00 P.M.—June 1, 1949

Committee Report—Policy on Fluoridation of Public Water Supplies..A. P. Black, *Chairman*
Recent Research on the Transmission of Poliomyelitis—With Particular Reference to the Hypothetical Involvement of Water Supplies.....K. F. Maxcy
Panel Discussion—Water Supply Quality.....*Led by* A. D. Weston, A. N. Beck, C. R. Cox, T. A. Filipi and D. B. Lee

General Session—9:30 A.M.—June 2, 1949

Minimizing Service Interruptions Derived From Transmission Line Failures...W. W. Brush
Discussion.....S. L. Kerr
Discussion.....H. T. Mann
Atlanta Adopts Modern Billing Methods and Equipment.....Paul Weir
Panel Discussion—Rethinking Water Rate Structures.....*Led by* L. E. Ayres, C. H. Capen, E. F. Dandridge, R. H. Ellis, M. P. Hatcher, N. B. Jacobs, A. P. Learned, Reeves Newsom and H. F. Smith

General Session—2:00 P.M.—June 2, 1949

Panel Discussion—Water Departments' Use of Radio.....*Led by* M. B. Cunningham, N. S. Bubbis, Adolph Damiano, F. E. Dolson and Carl A. Hechmer
Advantages and Limitations of Automatic Equipment.....V. C. Lischer
Steel Pipe Inspection—Ten Helpful Hints.....Edward J. Clark
Discussion.....F. M. Randlett
Discussion.....R. C. Beam
A History of the Development of Water Works Pumping Equipment.....G. M. Hinkamp

Water Purification Division—2:00 P.M.—June 2, 1949

Committee Report—Open Air Reservoirs.....N. J. Howard, *Chairman*
Committee Report—Disposal of Wastes From Purification and Softening Plants.....
W. W. Aultman, *Chairman*
Purification Wastes.....Paul D. Haney
Softening Wastes.....A. P. Black
Committee Report—Loading Capacities of Water Treatment Plants.....
H. O. Hartung, *Chairman*
Committee Report—Water Distribution System Problems.....J. C. Vaughn, *Chairman*
Committee Report—Standard Methods for the Examination of Water and Sewage.....
R. L. Derby, *Chairman, A.W.W.A. Committee*
H. A. Faber, *Chairman, Joint Editorial Board*

Water Resources Division—9:30 A.M.—June 3, 1949

Effects of Impoundages on Water Supply Quality in the Tennessee Valley.....
F. W. Kittrell and F. W. Thomas
Open Forum—Effect of Land Use on Siltation of Reservoirs.....*Led by* H. E. Hudson,
C. B. Brown, H. B. Shaw and J. S. Longwell

Committee on Water Works Practice—9:30 A.M.—June 3, 1949

Proposed Standards for Deep Well Turbine Pumps.....P. H. Brown
Survey Report—Effects of Pump Lubricants Upon Quality of Water From Deep Wells....
L. E. Ordelheide
Open Discussion—Water Works Practice Committee Projects.....

This Month's Cover

California's calamitous water shortage has its citizens avidly eyeing everything wet, if not damp. Whether this was in his mind when George de Gennaro of the Los Angeles Dept. of Water & Power snapped this shot for the department's magazine, *Intake*, we aren't quite sure, but even sans thirst we must agree that water can be beautiful. Yosemite's "big drop," incidentally, totals some 2,526 ft., including upper and lower falls and the intermediate cascades and rapids. And if that water is to go into California's bucket, we ask only that they impail it below the point pictured. After all where could they even *buy* an aerator like that?

Papers Scheduled at 1949 Section Meetings

THERE follows a summary listing of papers scheduled for presentation at 1949 Section Meetings. The dates of the Section Meetings from 1945 to 1949 and locations for 1949 are given on page 1150. Section officers who were elected at meetings held during 1949 are listed on page iv of this issue. The programs are listed alphabetically by Sections, without regard to date of presentation.

Alabama-Mississippi Section—October 19–21, 1949

Address of Welcome.....*Mayor* Allen C. Thompson
Response.....Baxter F. Wade
Trials and Tribulations of a Small-Town Water Works Operator.....Tip H. Allen
Discussion.....E. M. Stickney
Discussion.....Alex O. Taylor
The Relationship Between the State Board of Health and Public Water Supplies..A. N. Beck
Discussion.....H. A. Kroeze
Discussion.....William E. Hooper
Filtration Plant Problems and Chemical Removal of Manganese Deposits From Filters.....
C. W. White
Discussion.....Clarence D. Lamon
Discussion.....William O. Mullins
Distribution System Operation and Maintenance.....W. Victor Weir
Discussion.....Clifton C. Williams
Discussion.....Marion G. Stewart
Selection and Maintenance of Water Meters.....Jens Duus
Discussion.....Elmer L. Myers
Discussion.....R. M. Striger
Installation and Operation of Vertical Turbine Pumps.....R. M. King
Discussion.....Roy Stott
Discussion.....J. H. Pepper
Financing Water Works Construction.....Sidney J. Mohr Jr.
Discussion.....William E. Johnson
Submersible Pumps.....*A Motion Picture*

Arizona Section—April 1–3, 1949

Removal of Fluorides From Water Supplies.....George Swem
Discussion.....H. V. Smith
Experiences of a Sewage Operator in Public Relations.....W. H. Wisely
Public Relations in Water Works.....John C. Luthin
Operators' Roundup.....*Led by* Guy A. Rhoads
Bacteriology.....W. W. Mason
Repair of Reservoirs.....M. E. Devine
Round Table Discussion.....*Led by* A. W. Miller
Horizontal and Vertical Pumps and Their Applications.....T. R. Mackay
Prescott Water Supply.....Stuart Henderson and Cecil Overstreet
Operators' Roundup.....
Panel Discussion—Cost Engineering.....*Led by* John C. Luthin

Arizona Section—November 11–13, 1949

Underground Arteries.....*A Motion Picture*
Centrifugal Pumps—Application and New Development.....H. A. Mylander
Protection of Distribution Mains.....O. C. Hopkins
Discussion.....George W. Marx
Discussion.....E. A. Reinke
The Reclamation of Water From Sewage and Industrial Wastes in Los Angeles County.....
Russell G. Ludwig and Harvey Ludwig
Simple Biology of Sewage Treatment.....Charles E. Trygg
Panel Discussion—Financing Water and Sewer Main Extensions....*Led by* W. Victor Weir,
Richard Bennett and Clyde Mathews
Industrial Wastes Treated by One-Man Triple Play.....A. W. Tesmer
Erection of an Elevated Water Sphere.....*A Motion Picture*
Yuma Water Plant.....W. W. Williams
Report of Committee on Operators Schools and Certification.....John A. Carollo
Panel Discussion—Distribution System Consumer Complaints....*Led by* Jack J. Hinman Jr.,
John Luthin and Dale Cox
Chemical Limits in Drinking Water Standards.....Lester M. Louden
Water Pollution Control Under Public Law 845.....R. F. Poston
Horizontal Water Collectors.....Leland Glidden
Use of Asphalt in Hydraulic Works.....J. M. Lackey
Roundup of Afternoon's Program.....*Led by* George W. Marx

California Section—October 25–28, 1949

Address of Welcome.....*Mayor* Belle Cooledge
Response.....Lauren W. Grayson
Trenching and Backfill Requirements of Governmental Agencies.....Harmer E. Davis
Discussion.....M. K. Socha
Panel Discussion—Problems of Cooling-Water Supply and Disposal:
Water Supply.....Guy B. Cornell
Waste Water Disposal.....J. Carl Jennings
Panel Discussion—Per Cent Accounted-for Water.....*Led by* Leslie A. Hosegood
Questionnaire Summary of Experience of a Number of Water Works.....O. A. Gierlich
Experience of Long Beach in Accounting for Water.....C. Kenyon Wells
Water Waste Surveys as a Means of Reducing Unaccounted for Water.....E. D. Case
State Water Plan—Requirements for All Beneficial Uses.....William L. Berry
The Practical Aspects of Water Hammer.....Alexander C. Rener
New Developments in Wells for Supply and Recharge.....C. E. Jacob
Panel Discussion—Small Water Works Operation Problems.....*Led by* R. W. Adcock,
Harold R. Hushbeck, Loy E. Cook, James A. Wyatt and Arthur W. Holsworth
Cation Exchangers for Municipal Water Softening.....Lee Streicher and A. E. Bowers
Discussion.....*Led by* D. N. Dickinson
Maintenance of Free Residual Chlorine Throughout a Distribution System:
Experiences at Santa Rosa.....K. W. Brown
Experiences at Glendale.....Carl Wilson
Treatment of Water Containing Radioactive Wastes.....Ray L. Derby
Discussion and Demonstration of Radioactivity Protection Devices.....Fred R. Ingram
Operating Characteristics of Upflow Clarifiers.....Jack W. Pratt
Discussion.....*Led by* Oscar C. Blumberg
Water-Operated Gadgets.....W. M. Tibbett
Discussion.....*Led by* E. W. Barbee
Modern Analytical Methods:
Newer Chemical and Colorimetric Methods.....J. J. Connors
Possibilities of New Bacteriological Techniques.....Harry G. Neumann
Discussion.....*Led by* J. R. Rossum

Purchasing and Procurement of Materials.....H. R. LaFortune
Development of Punch Card Accounting in the Long Beach Water Department.....Joe Kerr
Raw-Water Purchase Agreements With the United States Bureau of Reclamation.....
Richard L. Boke
Panel Discussion—Uniform Rules and Regulations.....
R. C. Kennedy, W. C. Welmon and John C. Luthin
Water Well Redevelopment by Explosives.....Robert M. Ebaugh
Sea Water as a Source of Fresh Water Supply.....Everett D. Howe
Discussion.....*Led by* W. W. Aultman
Poliomyelitis and Water Supplies.....A. C. Hollister
Panel Discussion—Problems of Long Transmission Lines.....
Carl A. Lauenstein and J. W. Trahern

Canadian Section—April 25–27, 1949

The Quebec Water Works System.....J. A. Tremblay
Guided Discussion—Financing of Water Works Systems.....*Led by* W. Storrie
The Use for Public Relations in Canadian Water Works Practice.....Norma Nelson
The Value of Laboratory Examinations in the Control of Water Treatment...F. W. Gilcreas
Guided Discussion—Standardization of Corporation Cocks and Service Lines.....
Led by R. H. Martindale
Free Residual Chlorination at Brantford.....D. B. Williams
Discussion.....A. E. Griffin
Discussion.....J. F. MacLaren
Guided Discussion—Meeting Peak Demands in Water Supply.....*Led by* W. D. Hurst
Water Consumption in Canadian Municipalities.....H. R. Hooper
Guided Discussion—Salaries and Working Conditions for Water Works Personnel.....
Led by J. W. Peart
Guided Discussion—Miscellaneous Water Works Problems.....*Led by* G. H. Baker

Chesapeake Section—November 2–4, 1949

Environmental Sanitation.....*A Motion Picture*
Address of Welcome.....C. H. Whitesell
Response.....E. A. Schmitt
Quality Characteristics of Water Supplies in Middle Atlantic States.....S. K. Love
Practical Safety in Water Works.....R. L. Jenkins
Panel Discussion—Operating Aspects.....*Led by* H. R. Hall
Plant Shutdowns for Repairs and Improvements.....D. M. Watt
Experiences at a Small Plant.....Laurel F. Gosnell
Summer Problems.....J. M. Jester
Discussion.....
Life Stream.....*A Motion Picture*
New Look Keynote.....A. P. Black
Biological Problems of Middle and Old Age Reservoirs.....Charles Renn
Expansion of Elkton, Md., Water Supply System.....R. T. Regester
Lazaretta-Fort McHenry-Fairfield Subaqueous Water Main.....J. S. Strohmeyer
Not a Drop of Water.....*A Motion Picture*
Anthrafilt Filtering Media Through Two Decades.....G. M. Hitchcock
Obtaining Technical Services for Small Communities.....T. M. Niles
Occupational Health Hazards in Water Works Systems....W. H. Cary Jr. and P. J. Valaer
Panel Discussion—Sanitary Districts.....*Led by* E. R. Cotton
Procedure for Organizing Sanitary Districts.....Alvin Pasarew
Financing Projects.....N. L. Smith
Public Authorities in Pennsylvania.....J. R. Hoffert
Discussion.....

Panel Discussion—Looking at a Distribution System.....*Led by* D. V. Auld
System Design Practices and Procedures.....R. L. Orndorff
Application of Maps to System Planning.....J. B. Allen
Operations to Increase Efficiency of Existing Systems.....J. R. Mitchell
Discussion.....
Panel Discussion—Benefits of Short-Course School for Management and Plant Operators....
Led by J. C. Geyer
Status of Short-Course School for Chesapeake Section Water Works Operators.....
C. A. Hechmer
Importance of Participation by Municipal and Private Officials and Operators..I. M. Glace
Future Short-Course School Activities in Relation to State Health Departments..G. L. Hall
Reflections and Comments on Short-Course Schools.....A. H. Cline
Discussion.....

Cuban Section—December 1–3, 1949

Program not available.

Florida Section—November 14–16, 1949

Address of Welcome.....*Mayor* William S. Beardall and J. T. Branham
Response.....W. W. Gillespie
Pertinent and Impertinent Remarks.....Buell Duncan
Greetings From the President.....A. P. Black
The Fundamental Water Problem in Florida.....A. G. Matthews
Salt Water Intrusion in Florida, Past and Present.....Nevin D. Hoy
Orlando's New Water Treatment Plant.....E. L. Allen
The Financing of Water Improvements in Florida.....Townsend Wainwright
Havana Increases Its Water Supply.....Jose Garcia-Montes
Electric Motors and Controls for Use in Water Works Systems.....O. L. Cantrall
The Present Status of Public Water Supplies in Florida.....J. S. Telfair Jr.
High-Capacity Zeolites.....F. K. Lindsay
Distribution System Operation and Maintenance.....
L. H. Lutz, D. W. Jones and H. L. Berkstresser

Illinois Section

No regular meeting scheduled.

Indiana Section—April 20–22, 1949

Flocculation.....S. L. Tolman
At Your Service, Willing Water.....*A Motion Picture*
Main Disinfection.....B. A. Poole
Air Conditioning.....Frank C. Amsbary Jr.
Discussion.....George Fassnacht, T. R. Davis, D. P. Morse and G. V. Savage
Water Main Extensions.....F. R. Witherspoon
Panel Discussion.....*Led by* L. S. Finch,
H. J. Draves, Jack Gordon and Everitt Robbins
Planning for the Future.....M. P. Hatcher
Discussion.....J. B. Wilson and Paul Frame
Rate Increases.....Thomas Burrin
Discussion.....D. P. Backmeyer, L. G. Hall and H. B. Steeg
Preliminary Studies on a Method for Determining Aquifer Permeability by Electric Logging.....W. G. Keck

Iowa Section—October 6–7, 1949

Address of Welcome.....*Mayor* Thomas J. Smith
Response.....Roy Ellis
Panel Discussion—Meter Practices and Repairs.....*Led by* Karl G. Myrberg and Wilbur Bjork
Panel Discussion—Benefited Water Districts Outside the City.....*Led by* Dale Maffitt, Joe J. Hail, Walter W. Molis and John Pray
Developments in Medical Aspects of Water Treatment.....Ralph H. Heeren
Fire Insurance Rates and Their Relation to Water Supply.....Harry J. Corcoran
Water Treatment as Practiced in Japan.....Jack J. Hinman Jr.
Recent Advances in Water Treatment.....A. P. Black

Kansas Section—April 21–22, 1949

Address of Welcome.....*Mayor* H. C. McClintock
Greetings from A.W.W.A.....A. P. Black
Hutchinson Water System.....D. G. McCammant and Ivan W. Jones
Emergency Maintenance.....Orville G. Kauran
The Water Pollution Control Program of the U.S. Public Health Service.....Glen Hopkins
Maintenance of Rapid Sand Filters.....C. E. Palmer
Panel Discussion—Water Rate Changes.....Morris B. Willis and Lloyd B. Smith
Panel Discussion—Water Main Extension Policies....E. J. Allison and Charles P. Lightner
Geologic Methods of Prospecting for Ground Water.....O. S. Fent
Practical Experiences in Water Main Cleaning.....Robert Mounsey
Sand-Blasting Service Lines.....E. J. Trout
How to Dam the Dam.....B. H. Radar
Effortless Bill Collecting.....H. E. McMillen
Blowing Accuracy Into a Water Meter.....Charles F. McMannis

Kentucky-Tennessee Section—October 31–November 2, 1949

Address of Welcome.....*Mayor* Tom G. Mooney
Response.....G. R. Kavanagh
Experiences of an Operator in Public Relations.....W. H. Wisely
What the A.W.W.A. Can Do for Operators and Superintendents of Small Systems.....W. Victor Weir
Investigations on Radioactive Waste Disposal in Relation to Water and Sewage Treatment..O. R. Placak
Panel Discussion—Financing Water and Sewerage Improvements:
The Financier's Standpoint.....W. Howard Hopkin
What to Expect From Your Consulting Engineer.....L. H. Clouser
The Municipal Viewpoint.....L. S. Vance
Occurrence of Ground Water in Kentucky and Tennessee.....Dan K. Hamilton and H. B. Burwell
Panel Discussion—Changes in Water Rate Structures to Keep Pace With Increasing Production Costs:
Production Cost Trends.....R. W. Williamson
Water Rate Changes.....Charles L. Crangle
Rate Structures.....M. L. West
Effect of Consumer Meters on Consumption and Revenue.....R. T. Hosmon
Discussion.....G. R. Watkins
Cathodic Protection of Tanks.....Martin S. Roberts Jr.
Discussion.....J. W. McAmis
Operating Problems of Small Plants and Systems—Question and Answer Session.....*Led by* J. Wiley Finney Jr., W. H. Lovejoy, W. H. Johnson, Earl Mitchell, J. W. Lovell and T. C. Ragsdale
Continuous Plan of Leak Surveys and Detection.....Elwood Farra
Discussion.....W. T. Whittaker

Michigan Section—September 28–30, 1949

Address of Welcome.....*Mayor* Peter Clancy
News of the Field.....John E. Vogt
What You Should Know About Water Revenue Bonds.....Harvey Kenney
Recent Developments in Chlorine Dioxide Chemistry and Control.....Royden N. Aston
Liquid Alum—Preparation, Cost, Handling and Control.....L. I. Birdsall
What the State Health Department Expects of the Licensed Water Plant Operator.....
John M. Hepler
Chlorine Demand Constants of Detroit's Water Supply.....D. Feben and M. Taras
Preliminary Studies on the Relationship Between Chlorine Demand Constants and Specific Chemical Compounds.....M. Taras
Discussion.....Harry A. Faber
Ontonagon Solves Its Water Supply Problem With an Infiltration Gallery..George W. Francis
Methods for Making Water Service Extensions Beyond Corporate Limits:
Kalamazoo Method.....E. Norman
Wayne County Method.....Albert A. Campbell
Grand Rapids Method.....Charles W. Darling
Locating Ground Water by Electrical Resistivity Surveys.....William Keck
Experiences in Assisting Municipalities to Solve Ground Water Problems...Norman Billings
Hazards to Public Water Supplies From the Disposal of Industrial Wastes:
Lansing (Picric Acid).....Fred Krause
Douglas (Chromium).....T. Vander Velde
Ironwood (Chlorides).....R. Faust
Ann Arbor (Cyanides).....W. Muhlitner
Lowell (Chlorides).....F. J. McMahon
Interesting Results and Observations in the Change From Quarterly to Monthly Billing for Water Service.....H. E. Smith
The Value of Standards to the Water Works Industry.....Harry E. Jordan
Round Table Discussion—Critical Examination of the Tentative Minimum Standards of Design for Water Distribution Systems.....

Minnesota Section—September 8–9, 1949

A Tale of Two Cities.....*A Motion Picture*
Nitrates and Infant Cyanosis.....Herbert M. Bosch, A. B. Rosenfield, Roberta Huston, H. R. Shipman and F. L. Woodward
Discussion.....
New Concepts in Water Chlorination.....A. E. Griffin
Discussion.....
Rethinking Water Rate Schedules.....LeRoy Harlow
Discussion.....
Panel Discussion—Some New Developments.....*Led by* E. R. Mathews
Distribution.....
Purification.....
Softening.....
Panel Discussion—Problems of the Small Water Works.....*Led by* U. J. Seibert
Insurance Coverage—Plant and Personnel.....
Salaries.....
Purchasing and Accounting Procedures.....
Operation Problems.....
Synthetic Detergents and Municipal Water Softening.....Kenneth V. Hill
Discussion.....
Radioactivity—A New Criterion of Water Quality.....Arthur E. Gorman
Discussion.....

Missouri Section—September 25–27, 1949

Introduction.....C. E. Schanze
Response.....*Mayor* L. Russell McKee
Debate—Shall a Public Water Supply Be Metered or Not Metered:
For Metering.....Roger Higgins and Harry Hale
Opposed to Metering.....E. E. Easterday and A. W. Clarkson
Essentials of Public Fire Protection in Small Communities.....M. I. Parker
Effect of Well Pump Bearing Lubricants on Bacteriological Quality of Water Supplies.....
L. E. Ordelheide
Artificial Recharge of Ground Water.....Fred H. Klaer Jr.
Uniformity of Ground Absorption and Storage of Surface Water Underground.....
Harry C. Bolon
Electro Logging of Water Wells.....Edward L. Clark
The Biological Significance of Water.....Louis Stein
Pending Stream Pollution Legislation in Missouri.....W. Q. Kehr
Debate—Elevated Water Storage Versus Ground Storage and Pumps:
For Ground Storage.....F. E. Dolson and William E. Hansen
For Elevated Storage.....Vance C. Lischer and Raymond Bishop
Study of Water Rates Structure, Series No. 2.....Melvin P. Hatcher
New Concepts in Water Chlorination.....A. E. Griffin
American Water Works Association Affairs.....A. P. Black
Water Softening.....*A Motion Picture*

Montana Section—April 8–9, 1949

Address of Welcome.....*Mayor* Jhalmer C. Johnson
Response.....Joseph M. Schmit
Round Table Discussion.....*Led by* M. F. Dixon
Corrosion of Buried Metals.....Carl Davis
Water Chlorination in Principle and Practice.....Harry A. Faber
Nuclear Fission Products and Public Water Supply.....Claiborne W. Brinck
Fluorine in Drinking Water.....Francis I. Livingston
Water Main Extensions and Financing—Discussion.....W. Victor Weir

Nebraska Section—April 21–22, 1949

Address of Welcome.....*Mayor* Clarence G. Miles
Fluorine in Public Water Supplies.....Edmund J. Dailey
Bacteriological Tests.....C. E. Georgi
Welded Tank Construction.....George S. Trees
Installing Cast-Iron Pipe.....*A Motion Picture*
Sewage Disposal.....Vern Livingston
Municipal Liability for Water Main Breaks.....Thomas M. Davies
Report on Second Annual Water Works Conference....Roy M. Green and Niles H. Barnard

New England Section

No regular meeting scheduled.

New Jersey Section—November 17–19, 1949

Panel Discussion—Water Works Problems and Procedures Followed During the High Demand Period, Summer 1949.....*Led by* S. F. Newkirk Jr., George M. Haskew, J. Arthur Carr, Frank Knapp, Charles G. Bourgin and George Shanklin

Report of New Jersey Section, Water Supply Committee.....Charles J. Alfke
Symposium—Interpretation of the United States Public Health Service Standards With Particular Reference to Bacterial Quality.....*Led by* George Norcom, Joseph A. McCarthy, Charles H. Young and Bernard Kaplan
Standards in the Water Works Industry.....Harry E. Jordan
Panel Discussion—Small Plant Operation.....*Led by* Ivan M. Glace, Martin E. Flentje, A. J. Greco, J. J. Knapp Jr., N. S. Butera and E. Feldman
Future Planning for Water Department From the Water Commissioner's Standpoint..... William Fairhurst
Application of Telemetering to the Water Distribution System.....Adolph Damiano
Superintendents' Breakfast and Round Table Discussion.....*Led by* Walter Spencer

1. Air Conditioning (Water Department Rules and Regulations)
2. New A.W.W.A. Pipe Laying Specifications
3. Welding as a Tool for Maintenance in the Water Department
4. Disinfecting or Sterilization of New Water Mains
5. Increasing Percentage of Accounted-for Water by Using Meters Having Greater Sensitivity to Low Flows in Small Domestic Installations
6. Improving Water Department Emergency Procedures by Pre-analysis
7. Cathodic Protection

New York Section—April 28–29, 1949

Address of Welcome.....*Mayor* Emory Strachen
The Cold War Effect on Water Works Construction.....Harry E. Jordan
Revision of Water Rates in the Light of Present Day Costs.....Maurice R. Scharff
Water Rates Under Present Operating Conditions.....John H. Burwell
Public Interest in Water Rate Increases.....John H. Murdoch Jr.
A Simplified Bookkeeping System for Small Water Companies.....George J. Natt
Panel Discussion—Water Main Extension Policies.....*Led by* Allan H. Rogers, Lewis B. Smith, Harry B. Miles, John L. Farley Jr. and Alfred M. Roberts
Water Works Round Table Conference.....*Led by* S. P. Carman

Legislation.....
Water Treatment.....
Diesel Engines.....
Service Installation Methods.....
Labor Problems.....
Well Drilling.....
Discharge Pits.....

New York Section—September 6–7, 1949

Address of Welcome.....*Mayor* Harry Campbell
The Public Service Commission in Relation to Water Supply Rates and Practices..... Glen R. Bedenkapp
Employee Communications.....Allan Stockdale
Utility Finance.....Lovett C. Peters
Water Pollution Control Program of New York State.....Earl Devendorf
Panel Discussion.....*Led by* Simon P. Carman

Diesel Engines.....
Labor Problems.....
Legislation.....
Ground Water Supplies.....
Water Softening.....
Water Works Schools.....
Upflow Flocculation.....
Diatomaceous Filters.....

North Carolina Section—November 7–9, 1949

Address of Welcome.....*Mayor* C. N. Page
Experiences in Extending City Limits.....George S. Moore
Discussion.....
This Business of Water Supply and Sewage Disposal—Today and Tomorrow..Linn H. Enslow
Water Works Discussion Panel.....*Led by* Stanford E. Harris
Water Main Joint Materials.....J. W. Dandridge
New Main Sterilization and Testing.....J. W. Setzer
Meter Testing, Maintenance and Repairs.....J. E. Moses
Testing, Cleaning and Disinfection of Wells.....W. S. McKimmen
Safety Practices in Plant Operation.....William Piatt Jr.
Records for Small Water and Sewage Plants.....J. M. Jarrett
Rates for Special Services.....D. M. Williams
Water and Sewage Practices in Europe.....C. E. Perkins
Experiences With Fluoridation.....R. S. Phillips
Historical Reminiscences.....Frank E. Hale
Contamination of Water With Radioactive Substances.....Arthur E. Gorman
Industrial Use of Streams—A Second Look.....L. L. Hedgepeth
Federal Government's Activities in Stream Pollution Abatement.....Lewis A. Young

Ohio Section—November 3–4, 1949

Essentials of a Good Small Water Works.....Carleton S. Finkbeiner
Panel Discussion—Lapses in Water Quality.....*Led by* H. P. Cowgill, D. P. Griffin, W. R. Wagoner and W. E. Spies
Public Relations at Work.....*A Motion Picture*
Radioactive Disposal Problems as Related to Water Supply.....Lloyd R. Setter
Are Your Water Rates Adequate?.....M. W. Tatlock
Panel Discussion—Increasing Efficiency of Meter Reading.....*Led by* W. R. LaDue, J. P. Reinheimer and E. E. Smith
When Should Meters Be Scrapped?.....Wylie Davis
Discussion.....L. W. Bausher
Main Sterilization Procedures.....A. E. Griffin
Surplus Water Sales—A Statement of Policy.....John Peurifoy
Underground Arteries.....*A Motion Picture*
Emergency Communication Between Office and Field.....Leslie P. Sharpe
Treatment Problems in Small Water Plants.....O. F. Schoepfle
Discussion.....M. L. Riehl
Microorganisms in Water Supplies.....Kenneth E. Damann
Safety in and Around the Plant.....Homer Knox
Cleaning or Replacement of Filter Sand and Gravel.....R. W. Campbell
Versenate Method vs. Other Methods of Determining Hardness.....C. O. Hostettler
The Operator and the Consulting Engineer.....D. D. Heffelfinger
Panel Discussion—Financing Main Construction.....*Led by* Philip Burgess, E. E. Hagerman and Paul D. Cook
Illegal Demands on Department Funds.....J. E. Gotherman
Emergency Shutdowns.....Carl Eberling
Discussion.....W. W. Morehouse
Progress on Pollution Problems Under Ohio River Compact.....Kenneth S. Watson
General Pollution Problems.....Homer Knox
The Value of Standards to the Water Works Industry.....Harry E. Jordan
Recarbonation at St. Marys.....Robert E. Shoup
Panel Discussion—Breakpoint Chlorination and Tastes and Odors....*Led by* L. A. Marshall, E. B. Evans and Paul Laux
Emergency Connections—Intercity and Industrial.....A. V. Agnew
Discussion.....A. S. Hibbs

Inventories for Mutual Benefit.....Jack Bayless
Design Features of the Nottingham Intake.....Harry H. Moseley
Softened Water Evaluated.....R. S. Banks
Discussion.....Paul Laux
Plans for Dayton's New Water Plant.....W. W. Morehouse

Pacific Northwest Section—May 12–14, 1949

Address of Welcome.....*Mayor* Don E. Satterlee
Response.....James E. Morrison
Discusssions—1948 Flood Damage to Water Systems in the Pacific Northwest:
Idaho.....H. C. Clare
Oregon.....H. Moretty
Washington.....Marion T. Sterling
British Columbia.....R. Bowering
Water Resources Investigations of the U.S. Geological Survey in the Pacific Northwest.....
F. M. Veatch
Short Schools and Registration.....Curtiss M. Everts Jr.
Public Relations in Action.....Fred Merryfield
Deep Well Pumps and Related Problems.....Marius Anderson
Discussion.....*Led by* E. K. Erickson
Cross Connections.....E. J. Allen
Discussion.....*Led by* Omar C. Hopkins
Round Table Discussion—Operators' Problems:
Maintenance.....N. R. Mayhew
Treatment.....Winston H. Berkeley
Distribution.....Alden W. Anderson
Water Chlorination in Principle and Practice.....Harry A. Faber
Jack Frost and the Water System in 1949.....Fred D. Jones
Prestressed Circular Concrete Reservoirs.....H. Loren Thompson
Discussion.....*Led by* Gordon Ingman
Effect of the Use of Water Works Income for General Municipal Purposes.....
W. Chester Morse
Elevated Tank Repairs in Idaho.....Bert Terry
Discussion.....*Led by* H. C. Clare
Algae.....*A Motion Picture*
Water Treatment.....Lee F. Chaney

Pennsylvania Section—September 14–16, 1949

Address of Welcome.....*Mayor* Claude R. Robins
What the Clean-Streams Program Will Mean to Pennsylvania Water Works...H. E. Moses
Discussion.....E. C. Trax
Discussion.....John F. Kegebein Jr.
Panel Discussion—Service Materials and Service Main Construction.....
Led by Charles P. Abraham,
Edwin C. Goehring, C. H. Davis, G. V. Gustafson and John D. Johnson
An Unusual Water Supply Problem.....J. D. Carpenter
The Status of Water Fluoridation in 1949.....Harry A. Faber
Discussion.....L. G. Grace
Panel Discussion—Policies Concerning Metering, Service Main Extensions and Shut-offs.....*Led by* Edgar O. Kable,
Walter H. Bottelsen and Carl I. Kear
Development of the New Water Supply for the City of Chester.....Francis S. Friel
Discussion.....Kenneth C. Armstrong

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Discussion.....Guy Palmes
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Discussion.....Angus Slee
Discussion.....J. S. Nichols
Collection and Distribution of Water.....J. Orville Jones
Discussion..... Ray L. Sherard
Discussion.....Thomas J. Eaton
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Algae Control and Photomicrographs.....George J. Turre
General Discussion.....
Pipe Jointing Compounds.....Frank Rosich
Discussion.....William H. Millikin
Status of Water Works Materials.....Dana E. Kepner
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Distribution System.....Bert Saxon
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Fish and Game.....H. B. Fowler
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State Aspects.....G. F. Mathews
Oklahoma City as Example.....Guy B. Treat
Financing.....W. H. Sindt
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Recent Research on Transmission of Poliomyelitis.....James Watt
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Pumps.....Compere Loveless
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Aids in Laying Pipe by Mechanical Means.....James G. Carns
What Standards Mean to the Water Works Industry.....Harry E. Jordan
Industrial Water Supplies.....L. L. Hedgepeth
Moving Picture Symposium:
Underground Arteries.....
Submersible Deep Well Pump and Motor.....
Air, Water and Industry.....
Slugs of Bugs.....Charles E. Renn
Applying A.W.W.A. Water Well Standards.....Paul Schweitzer
Water Supply for Fire Protection in Growing Municipalities.....Kenneth J. Carl
Panel Discussion—Policies of Providing Water Service Beyond Corporation Limits of Towns and Cities.....*Led by* Charles E. Moore, H. E. Lordley, X. D. Murden, R. D. Wright and R. L. Morrison

West Virginia Section—September 22–23, 1949

Chlorine Dioxide.....A. L. Debeau
Discussion.....A. R. Todd
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Safety Problems.....Milo Gray
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New Water Rules and Regulations of the West Virginia Public Service Commission.....Earle Morris
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Licensing and Training of Water Plant Operators in West Virginia—Round Table Discussion.....H. K. Gidley, H. W. Speiden, Perkins Boynton, Lawrence Haynes and A. R. Todd

Wisconsin Section—October 11–13, 1949

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Discussion of Specifications for the Installation of Cast-Iron Water Mains.....Joseph P. Schwada and Eugene J. Voelker
Design of Water Distribution Systems.....C. W. Ward
Round Table Discussion—Distribution System.....
Electron Microscope and Its Possibilities in Control of Water Treatment....John R. Baylis
Development of Water Works Pumping Equipment.....Grant M. Hinkamp
Round Table Discussion.....*Led by* Harold T. Rudgal
Quantitative Determination of Ground Water in Wisconsin.....W. J. Drescher
Getting Water From the Ground.....J. W. Gibb
Panel Discussion—Ground Water..E. F. Bean, H. E. Wirth, Joe Egerer and Morris O. Nelson
Water Rate Structures.....Orville Deule
Fire Protection Service Charges.....Preston A. Reynolds and George K. Hood
Round Table Discussion.....*Led by* Zenno A. Gorder

Section Meetings—1945–1949

Section	*1945*	*1946*	*1947*	*1948*	*1949*	*Meeting Place—1949*
Alabama-Mississippi	——	——	May 23–24	Oct. 13–15	Oct. 19–21	Jackson, Miss.
Arizona	——	——	Oct. 9–11	Apr. 2–4	Apr. 1–3	Prescott, Ariz.
				Oct. 15–17	Nov. 11–13	Yuma, Ariz.
California	Oct. 23–25*	Oct. 22–25	——	Oct. 27–29	Apr. 29*	Bakersfield, Calif.
					Oct. 25–28	Sacramento, Calif.
Canadian	Mar. 19–21	Apr. 8–10	Apr. 14–16	Apr. 12–14	Apr. 25–27	Quebec, Que.
Chesapeake				——	Nov. 2–4	Washington, D.C.
Cuban	——	Nov. 22–24	Nov. 20–22	Dec. 2–4	Dec. 1–3	
Florida	Nov. 15–17	Nov. 22–24	Nov. 20–22	Nov. 18–20	Nov. 14–16	Orlando, Fla.
Four States	Dec. 13–15	Sept. 26–28	Nov. 19–21	Oct. 20–22	——	
Illinois	Oct. 30–31	——	Apr. 17–18	Apr. 15–16	——	
Indiana	June 12–22*	Apr. 2–3	May 7–9	Apr. 21–23	Apr. 20–22	Indianapolis, Ind.
Iowa	——	Nov. 4–5	Oct. 9–11	Oct. 5–6	Oct. 6–7	Burlington, Iowa
Kansas	——	Mar. 7–8	Mar. 13–14	Mar. 11–12	Apr. 21–22	Hutchison, Kan.
Kentucky-Tennessee	June 4–5	Oct. 28–30	Sept. 22–24	Aug. 23–25	Oct. 31–Nov. 2	Lexington, Ky.
Michigan	Sept. 19–20	Sept. 18–20	Sept. 18–20	Sept. 22–24	Sept. 28–30	Traverse City, Mich.
Minnesota	Sept. 11–18*	Mar. 14–15	Mar. 13–14	Sept. 1–2	Sept. 8–9	Minneapolis, Minn.
Missouri	——	Oct. 21–22	Oct. 27–28	Oct. 24–26	Sept. 25–27	Joplin, Mo.
Missouri Valley	Oct. 29–30	——	——	——	——	
Montana	Apr. 13–14	Apr. 12–13	Apr. 25–26	Apr. 9–10	Apr. 8–9	Great Falls, Mont.
Nebraska	——	——	Apr. 11–12	Apr. 22–23	Apr. 21–22	Lincoln, Neb.
New England	——	Oct. 17	——	——	——	
New Jersey	Jan. 29	Mar. 1	Feb. 19	——	Feb. 17	Newark, N.J.
	July 25	——	June 19	——	June 23	Wanaque, N.J.
	Nov. 8–10	Nov. 7–9	Nov. 6–8	Nov. 4–7	Nov. 17–19	Atlantic City, N.J.
New York	Jan. 17	Mar. 28–29	Apr. 10–11	Apr. 1–2	Jan. 21	New York, N.Y.
	May 22–25*	Oct. 3–4	Sept. 4–5	Sept. 14–17	Apr. 28–29	Elmira, N.Y.
					Sept. 6–7	Cooperstown, N.Y.
North Carolina	Nov. 5–7	Nov. 18–20	Nov. 10–12	Nov. 8–10	Nov. 7–9	Southern Pines, N.C.
Ohio	Oct. 23–26*	Oct. 10–12	Sept. 30–Oct. 2	Oct. 7–8	Nov. 3–4	Dayton, Ohio
Pacific Northwest	——	May 23–25	May 15–17	May 13–15	May 12–14	Bellingham, Wash.
Pennsylvania					Sept. 14–16	Harrisburg, Pa.
Rocky Mountain	Sept. 21	Sept. 12–13	Sept. 25–26	Sept. 15–17	Sept. 21–23	Colorado Springs, Colo.
Southeastern	——	Sept. 9–11	Nov. 3–5	Dec. 6–8	Dec. 5–7	Albany, Ga.
Southwest	Oct. 16–17	Oct. 14–17	Oct. 12–15	Oct. 11–13	Oct. 10–12	Oklahoma City, Okla.
Virginia	Nov. 8–9	Nov. 14–15	Nov. 17–18	Oct. 25–26	Oct. 24–25	Roanoke, Va.
West Virginia	Nov. 15–16	Oct. 17–18	Oct. 2–3	Sept. 30–Oct. 1	Sept. 22–23	Wheeling, W.Va.
Western Pennsylvania	Sept. 14	Sept. 12–13	June 12–13	Oct. 20–22	——	
Wisconsin	Nov. 13–15	Nov. 15–17	Oct. 23–25	Oct. 28–29	Oct. 11–13	Milwaukee, Wis.

* Regional meetings.

Section Membership at Time of, and Total Attendance at, Section Meetings—1945–1949

SECTION	1945		1946		1947		1948		1949	
	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance
Alabama-Mississippi	*	*	*	*	52	87	137	116	164	140
Arizona‖	*	*	*	*	26	134	41	159	69	181
California‖	663	503	684	857	726	§	770	1133	826	831
Canadian	353	800	383	600	404	730	459	732	485	574
Chesapeake	*	*	*	*	*	*	*	*	209	196
Cuban	38	‡	36	26	36	116	36	75	57	†
Florida	134	120	149	142	165	116	190	103	216	174
Four States	336	202	343	172	350	180	343	191**	#	#
Illinois	330	219	353	‡	362	318	402	321	450	‡
Indiana	206	386	203	226	206	224	201	242	207	266
Iowa	*	*	67	106	93	115	95	157	102	138
Kansas	*	*	55	107	93	132	110	118	113	168
Kentucky-Tennessee	129	†	131	98	132	133	138	206	196	153
Michigan	150	152	181	230	199	222	232	248	254	211
Minnesota	120	146	120	179	161	206	172	322	182	169
Missouri	*	*	154	†	150	88	154	76	157	62
Missouri Valley	294	166	254	§	#	#	#	#	#	#
Montana	57	43	59	78	61	69	63	108	61	94
Nebraska	*	*	*	*	35	†	41	†	54	18
New England	161	‡	170	57	172	‡	172	‡	187	‡
New Jersey‖	291	91	305	250	309	217	320	208	339	218
New York‖	526	332	575	126	627	230	644	200	643	250
North Carolina	156	272	162	237	169	212	174	238	171	226
Ohio	267	†	332	†	336	251	364	258	380	308
Pacific Northwest	228	‡	267	234	267	234	264	260	277	267
Pennsylvania	*	*	*	*	*	*	*	*	345	147
Rocky Mountain	94	90	103	84	117	92	135	74	147	86
Southeastern	231	‡	238	179	151	136	149	154	152	†
Southwest	359	211	434	430	557	428	558	545	659	618
Virginia	122	175	125	219	146	201	154	224	167	228
West Virginia	76	†	80	131	82	120	88	172	87	123
Western Pennsylvania	152	155	159	115	157	132	159	191**	#	#
Wisconsin	129	255	133	272	138	302	146	239	143	301

* Section not then organized.

† No record of attendance.

‡ No regular meeting scheduled. Membership given as of dates of conferences for 1946–1949, and as of June 30, 1945.

§ Regular meeting cancelled. Business meeting held at annual conference.

‖ Only one meeting recorded here.

\# Section discontinued.

** Joint meeting, to form Chesapeake and Pennsylvania Sections.

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7A.5–1940—STANDARD SPECIFICATIONS FOR COAL-TAR ENAMEL PROTECTIVE COATINGS FOR STEEL WATER PIPE OF SIZES 30 INCHES AND OVER—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A.W.W.A. on April 25, 1940. Revised October 3, 1949. 28 pp. Reprinted under same cover as 7A.6–1940, description of which follows.

7A.6–1940—STANDARD SPECIFICATIONS FOR COAL-TAR ENAMEL PROTECTIVE COATINGS FOR STEEL WATER PIPE OF SIZES UP TO BUT NOT INCLUDING 30 INCHES—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A.W.W.A. on April 25, 1940. 24 pp. Revised October 3, 1949. Reprinted under one cover with 7A.5–1940, 45¢.

7A.7–1941—STANDARD SPECIFICATIONS FOR CEMENT-MORTAR PROTECTIVE COATING FOR STEEL WATER PIPE OF SIZES 30 INCHES AND OVER—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A.W.W.A. on June 26, 1941. 16 pp. Reprint, 20¢. *Revision pending.*

7A.8–T—TENTATIVE STANDARD SPECIFICATIONS FOR FIELD WELDING OF STEEL WATER PIPE JOINTS—Approved as Tentative Standard Specifications by the A.W.W.A. on January 10, 1946 and by the American Welding Society on October 30, 1945. Published as part of the March 1946 JOURNAL. Revised October 3, 1949. 12 pp. Reprint, 20¢.

Concrete Pipe

7B.1–T—TENTATIVE STANDARD SPECIFICATIONS FOR REINFORCED CONCRETE WATER PIPE—STEEL CYLINDER TYPE, NOT PRESTRESSED—Approved by the A.W.W.A. on December 11, 1947, and published in the March 1948 JOURNAL. 14 pp. Reprint, 20¢.

7B.2–T—TENTATIVE STANDARD SPECIFICATIONS FOR REINFORCED CONCRETE WATER PIPE—STEEL CYLINDER TYPE, PRESTRESSED—Approved by the A.W.W.A. on November 21, 1949, and published in the December 1949 JOURNAL. 16 pp. Reprint, 20¢.

Specifications for Valves, Sluice Gates and Fire Hydrants

7F.1–1939—STANDARD SPECIFICATIONS FOR GATE VALVES FOR ORDINARY WATER WORKS SERVICE—Adopted by the A.W.W.A. on April 28, 1938 and published in the March 1939 JOURNAL. 12 pp. Reprint, 20¢.

7F.2–T—TENTATIVE SPECIFICATIONS FOR SLUICE GATES—Approved as Tentative Specifications by the A.W.W.A. on June 26, 1941 and published as a part of the October 1941 JOURNAL. 11 pp. Reprint, 20¢.

7F.3–1940—STANDARD SPECIFICATIONS FOR FIRE HYDRANTS FOR ORDINARY WATER WORKS SERVICE—Adopted as Standard Specifications by the A.W.W.A. on January 17, 1940. Includes "Characteristics of the National Standard Fire-Hose Coupling Screw Thread" and 7F.3.1–1937 (see below). Published as a part of the August 1940 JOURNAL. 12 pp. Reprint, 20¢.

7F.3.1–1937—SPECIFICATIONS FOR UNIFORM MARKING OF FIRE HYDRANTS—Published in the April 1937 JOURNAL and adopted by the A.W.W.A. on June 7, 1937. Included in 7F.3–1940, described above.

Other Specifications

4A.1–1946—STANDARD SPECIFICATIONS FOR DEEP WELLS—Published as Tentative Specifications as part of the September 1945 JOURNAL and adopted as Standard by the A.W.W.A. on May 10, 1946. 50 pp. Reprint, 45¢.

5C–T—TENTATIVE STANDARD SPECIFICATIONS FOR FILTERING MATERIAL—Originally approved by A.W.W.A. in March 1943 and published in April 1943 JOURNAL. Revision approved Nov. 15, 1948, and second edition published in March 1949 JOURNAL. 16 pp. Reprint, 20¢.

7H.1–1948—STANDARD SPECIFICATIONS FOR ELEVATED STEEL WATER TANKS, STANDPIPES AND RESERVOIRS—Originally published in the December 1940 JOURNAL and approved as Standard by A.W.W.A. on June 26, 1941. Revision approved Sept. 20, 1948 by A.W.W.A.; October 25, 1948 by American Welding Society; and Sept. 14, 1948, by New England Water Works Assn. Second edition published in April 1949 JOURNAL. 35 pp. Reprint, 35¢.

7H.2–T—TENTATIVE RECOMMENDED PRACTICE FOR INSPECTING, REPAIRING AND REPAINTING ELEVATED STEEL WATER STORAGE TANKS, STANDPIPES AND RESERVOIRS—Originally approved by the A.W.W.A. on June 15, 1943, and published as part of the July 1943 JOURNAL. Revised September 20, 1948, and republished as part of the October 1948 JOURNAL. Revised September 28, 1949. 23 pp. Reprint, 25¢.

Meters and Services

7M.1–1946—STANDARD SPECIFICATIONS FOR COLD WATER METERS—DISPLACEMENT TYPE—Published as Tentative Specifications as part of the December 1941 JOURNAL and adopted as Standard by the A.W.W.A. on May 10, 1946. Approved as Tentative Specifications by the New England Water Works Association on March 15, 1943. 12 pp. Reprint, 20¢.

7M.2–1947—STANDARD SPECIFICATIONS FOR COLD WATER METERS—CURRENT TYPE—Published as Tentative Specifications in the April 1946 JOURNAL and adopted as Standard by the A.W.W.A. on July 25, 1947. 12 pp. Reprint, 20¢.

7M.3–1947—STANDARD SPECIFICATIONS FOR COLD WATER METERS—COMPOUND TYPE—Published as Tentative Specifications in the April 1946 JOURNAL and adopted as Standard by the A.W.W.A. on July 25, 1947. 13 pp. Reprint, 20¢.

7M.4–1949—STANDARD SPECIFICATIONS FOR COLD WATER METERS—FIRE SERVICE TYPE—Published as Tentative Specifications in the February 1947 JOURNAL and adopted as Standard by the A.W.W.A. in January 1949. 12 pp. Reprint, 20¢.

7M.5–T—TENTATIVE STANDARD SPECIFICATIONS FOR COLD WATER METERS—CURRENT TYPE—PROPELLER DRIVEN. Approved by the A.W.W.A on July 21, 1949, and published in the August 1949 JOURNAL. 12 pp. Reprint, 20¢.

7S–CR—COLLECTED STANDARD SPECIFICATIONS FOR SERVICE LINE MATERIALS—These specifications were assembled and published as a report of A.W.W.A. Subcommittee 7S on Service Line Materials in the August 1948 JOURNAL, but are not official specifications of the A.W.W.A. 7 pp. Reprinted under same cover as 7T.1–1948, description of which follows.

7T.1–1948—STANDARD SPECIFICATIONS FOR THREADS FOR UNDERGROUND SERVICE LINE FITTINGS—Published as Tentative Specifications in the October 1947 JOURNAL and adopted as Standard on September 15, 1948. 8 pp. Reprinted under one cover with 7S–CR, 25¢.

R for Meter Readers—Suggestions for the meter reader to adopt in encounters with the customer's watchdog. A training manual in brief, as reprinted from *Public Relations at Work* No. 8, July 1949. 6 pp. (8½ by 11 in.). Reprint, 5¢.

Committee Reports and Recommended Practices

5B.3–1939—REPORT ON CHEMICAL HAZARDS IN WATER WORKS PLANTS—SULFUR DIOXIDE AND CAUSTIC SODA—Published in the March 1939 JOURNAL. 13 pp. Reprint, 30¢.

7G.1–1940—RECOMMENDED PRACTICE FOR DISTRIBUTION SYSTEM RECORDS—Reprint also includes "Economies in Office Forms" by Israel Rafkind and "Coordinating Operating System Records With Accounting Records" by Nathan B. Jacobs. Published in the February 1940 JOURNAL. Reset and printed without change in 1947. 52 pp. Reprint, 45¢.

5Z–T—TENTATIVE MANUAL OF CATION EXCHANGER TEST PROCEDURES—Originally approved in March 1943 and published in June 1943 as "Tentative Manual of Zeolite Test Procedures." Revision approved December 31, 1948, and second edition published in May 1949 JOURNAL. 28 pp. Reprint, 30¢.

GROUNDING OF ELECTRIC CIRCUITS ON WATER PIPES—A statement of A.W.W.A. policy and "Water Works Industry's Attitude on Grounding and Stray Current Problems" by Charles F. Meyerherm, reprinted from the April 1944 and December 1945 JOURNALS. 4 pp. Reprint, 10¢.

THE FLUORIDATION OF PUBLIC WATER SUPPLIES—A statement of recommended policy and procedure approved by A.W.W.A. on May 29, 1949, and published in the July 1949 JOURNAL. 5 pp. Reprint, 15¢.

Periodicals and Pamphlets

JOURNAL AMERICAN WATER WORKS ASSOCIATION—A monthly magazine of technical papers, discussions, news and reports. Issued quarterly from 1914 to 1919; bimonthly from 1920 to September 1924; monthly ever since. Annual indexes are contained in the December issue of each year from 1940 on. Cumulative indexes of authors and articles grouped by topics are described on p. 6. Subscriptions only in conjunction with A.W.W.A. membership in U.S., Canada and Cuba, or $7 to libraries. Not sold to individuals. Single copy price (of issues from 1925 on), for general sales, 75¢; to A.W.W.A. members, 50¢.

A STYLE MANUAL FOR JOURNAL AUTHORS—Tips and guides for the author and speaker. Includes an explanation of editing and publication procedure; directions for preparing tables, illustrations, footnotes and references for publication; a list of abbreviations used in the Journal A.W.W.A.; and an Appendix on the oral presentation. Reprinted from the May 1947 JOURNAL. 16 pp. 20¢.

A SURVEY OF OPERATING DATA FOR WATER WORKS IN 1945—A comprehensive tabulation of rates, income, costs and other vital statistics for 462 utilities serving communities of over 10,000 population. Published in the February 1948 JOURNAL. Paper bound reprint, 96 pp. 50¢.

Books

INDEX TO THE PROCEEDINGS AND JOURNAL A.W.W.A. (1881–1939)—This cloth-bound, 285-p. Index covers the Proceedings for 1881 through 1913 and the JOURNAL for 1914 through 1939. Price, for general sales, $2.00; to A.W.W.A. members who send cash with order, $1.50.

INDEX TO THE JOURNAL A.W.W.A., 1940–1944—Paper-bound supplement to the *Index to the Proceedings and Journal A.W.W.A.* Published as part of the March 1945 JOURNAL. 64 pp. Paper-bound reprint, $1.00.

MANUAL OF WATER WORKS ACCOUNTING—Prepared jointly by the A.W.W.A. and the Municipal Finance Officers Association, this 500-page Manual contains twenty chapters covering all utility accounting practices. Published in 1938. Price, for general sales, $4.00; to A.W.W.A. members who send cash with order, $3.20.

STANDARD METHODS FOR THE EXAMINATION OF WATER AND SEWAGE—Published jointly by the A.W.W.A. and the American Public Health Association. Ninth edition, 1946. Cloth bound, 300 pages. Available through the American Public Health Association, 1790 Broadway, New York 19, N.Y., at $4.00.

WATER-BORNE OUTBREAKS IN THE UNITED STATES AND CANADA AND THEIR SIGNIFICANCE—By Arthur E. Gorman and Abel Wolman. Published in the February 1939 JOURNAL, p. 225. This 150-page book is a unique compilation and a valuable interpretation. Published separately, paper bound, $1.00.

MANUAL OF WATER QUALITY AND TREATMENT—Published in 1940; reprinted in 1941. *Out of print.* Revised text in preparation.

SURVIVAL AND RETIREMENT EXPERIENCE WITH WATER WORKS FACILITIES—Prepared by a joint committee of the A.W.W.A. and the Institute of Water Supply Utilities. Includes reports published in installments in JOURNAL, 1945–46, with additional material and summary tables. Published 1947. Cloth bound, 566 pp. $3.00.

THE QUEST FOR PURE WATER—By M. N. Baker. First edition, 1948. A history of water purification from the earliest records to the twentieth century. 73 illustrations, 900 references, 544 pages. Price, for general sales, $5.00; to A.W.W.A. members who send cash with order, $4.25.

GLOSSARY—WATER AND SEWAGE CONTROL ENGINEERING—Almost 3,000 definitions of water and sewage works terms jointly compiled by A.W.W.A., A.S.C.E., F.S.W.A. & A.P.H.A. First edition, 1949. For the reference shelf. 276 pp. Sold to members only at $2.00, cloth-bound. Nonmembers should order from American Society of Civil Engineers, 33 W. 39th St., New York, N.Y.

Journal

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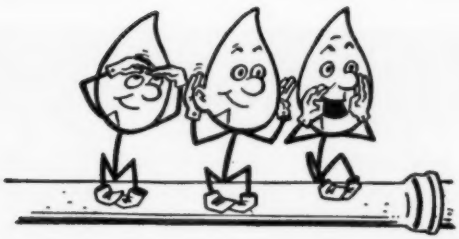


Percolation and Runoff

MERRY CHRISTMAS time's once more upon us, and this year, as last, we want to take the opportunity to unbeard the Santa Cli who have been filling our story stockings all through the year. Not just to deanonymize them either, we want to panegyrize, praise, extol, glorify, laud, eulogize and even thank our benevolent benefactors—the contributors—for providing the source from which our runoff flows. And if you, the subjected, are more disposed to bury than to praise them, consider only how much worse your fate if, by this means, they did not guide at least the direction of its flow. No! Peace, good will and not just a Merry Christmas, but a most prosperous New Year is only what they deserve.

We raise an ultrasonic paean, then, to E. L. Filby, P. S. Wilson and J. M. Wafer, three stalwarts whose countless contributions to the cause (if not the effect) of P&R entitle them to much more than this puny celebration. Having already conferred upon them our Order of the Observant Eye, we are hard put now to do them further honor. Thus, since we cannot reveal the fact that we have elected them, respectively, to the offices of Chairman, Director and President of Editors Anonymous, we must be content to wish them the same numberlessness of blessings that they have given us of contributions.

A paean, too, no less than supersonic, we raise to our theomorphic thirteen—W. N. Beadle, A. P. Black, R. K. Blanchard, C. H. Capen, A. T. Clark, R. E. Dodson, R. J. Faust, W. R. LaDue, M. G. Mansfield, A. B. Mawdsley, A. Santandrea, T. J. Skinker and G. E. Symons—who constitute the balance of the unmentioned membership of Ed. Anon. For their more numerable, though no less appreciated, contributions to the reservoir of P&R, they rate at least a flood of holiday cheer.

And, while we're feeling paeany, we'll not neglect those unnamed saints, the patrons, who recklessly read. Nor, certainly, will we skip a single one of those, at last innumerable, readers who *correspond*. To them, whose forbearance and, sometimes, even encouragement have permitted us to go on—and, perhaps too often, on and on—we owe much more than greetings, but greetings being what we've got, **MERRY CHRISTMAS!**

(*Continued on page 2*)

(*Continued from page 1*)

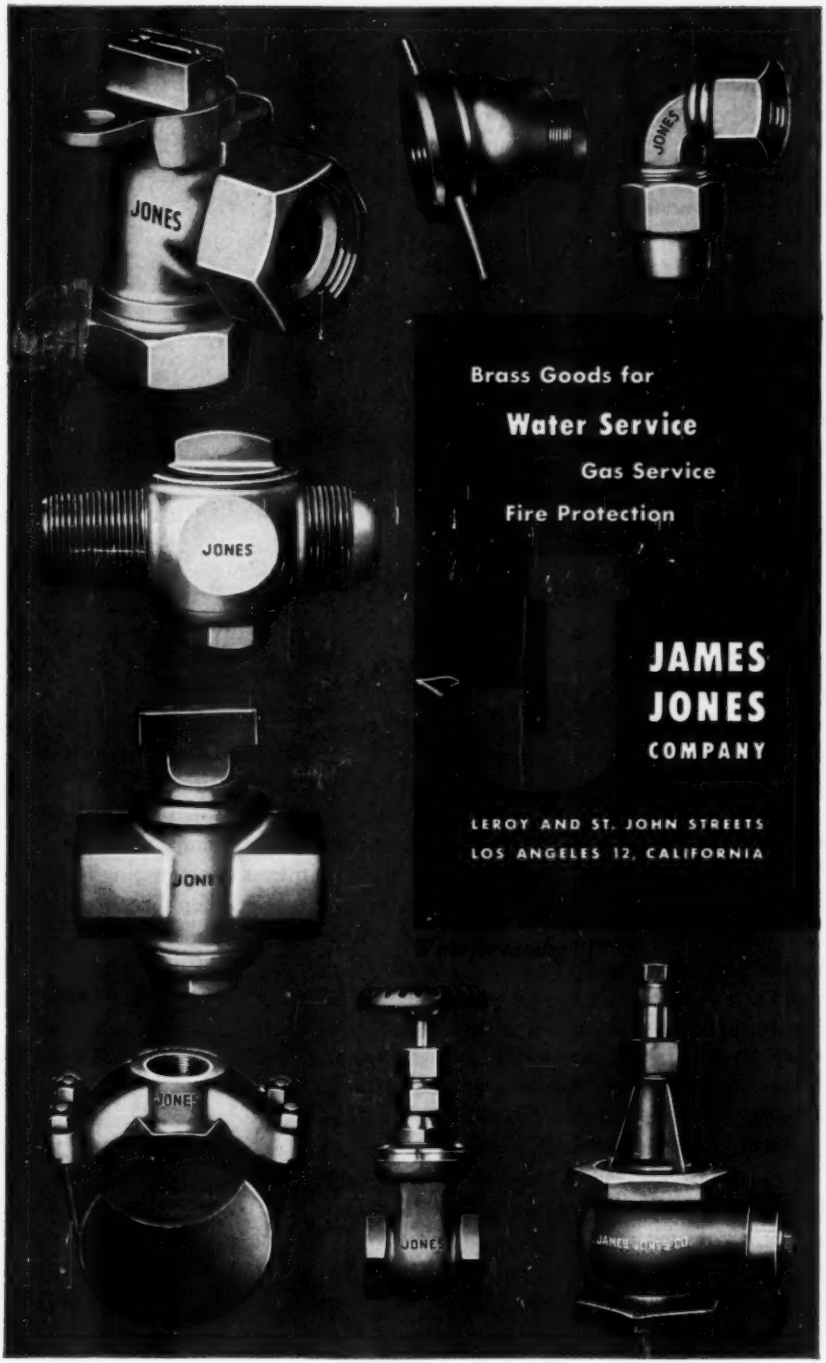
The postcard bill and check form, which seemed like such a bright idea when it was first broached (October 1948 issue, P&R, p. 2), has run into some heavy opposition from the nation's financial experts. The theory was that if the customer was sent a regular government double postcard form, on the reply end of which was noted the amount due and the name of the water utility in check form, the customer would only have to fill in the name of his bank, sign and mail the card in order to pay the bill. And it seems to have worked out that way in El Dorado, Kans., where city manager Harley E. McMillen instituted and applied for a patent on the method.

The American Bankers Association, however, is fundamentally opposed to postcard checks because of the increased forgery hazard involved when an uncovered check passes through many hands, because the size is nonstandard, and because postmarks may obliterate endorsements, etc. In addition, the combining of the bill with the check form makes for what the ABA calls a headache check, since the introduction of extraneous numbers and amounts for consumption, rate, etc., could cause confusion and possible errors in payment. The bankers have worked out certain standards for check size, content and arrangement which they feel will help them handle the millions of checks which go through their hands every day in an efficient and orderly way, and they object very strongly when nonstandard checks are substituted, since it understandably complicates their operations.

A Division of Engineering Resources in the Bureau of State Service, U.S. Public Health Service, has been created and M. Allen Pond, assistant chief sanitary engineer of the service, designated chief. The division is intended to centralize planning and development of Public Health Service programs in the rapidly expanding fields of sanitary engineering and environmental health.

Ideological pollution of its water supply was a new problem faced by the Peekskill Water Board last September as an aftermath of the ill-fated Paul Robeson concert and rally held on the Hollow Brook Golf Course near Peekskill, N.Y. Of course, no ideas could be isolated from the water samples taken, but plenty of pollution was there and it stemmed directly from the friction between the ideas of the rallyers and those of their hecklers. Since Hollow Brook, on which the golf course and the site of the rally are situated, is the sole source of Peekskill's supply, the board was able to obtain injunctive relief from future riot effluent in a consent decree awarded by the state supreme court, which restricted an area 500 ft. on both sides of the brook and made it necessary for the owners to obtain permission from state, county and local health authorities before scheduling meetings there. And we'll venture a guess that any future permission so granted will involve a clean bill of mental as well as physical health.

(*Continued on page 4*)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JONES
COMPANY
LEROY AND ST. JOHN STREETS
LOS ANGELES 12, CALIFORNIA

(*Continued from page 2*)

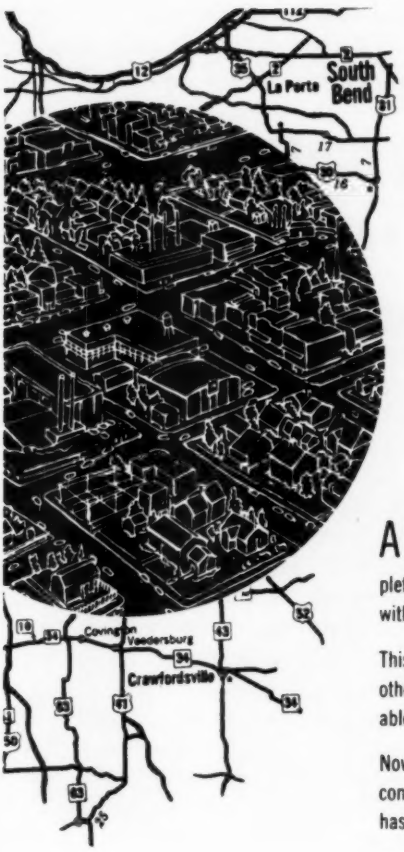
A monthly muse on news and views is one of those features we've always intended, but never quite managed, to undertake—partly, perhaps, because the dirt that filters into our Fifth Avenue aerie is the kind that blackens rather than informs, but even partlier because the leisure in which to muse, as well as the proper muselage, has always eluded us. Innocent, then, of any intent to begin now, we can still exclaim: What a month this would have been to muse:

About drought, for instance—Sitting here behind slightly less than a pound mound of local newspaper clippings concerning the effects of the current rainfall deficiency on the immediate New York metropolitan area, we can only guess that printers' ink must be flowing more freely than water these days, in a latter-day appreciation of the importance of an adequate water supply. And to have this plethora of publicity topped off by a front-page illustrated story in the conservative New York *Times* would in other days be almost too good to be true. Yet now, of course, water works men are too worried about the cause of their good fortune to enjoy its effect. And just as surely as a good rain will drown the worry, it will wash out even the memory of the appreciation. Ah, well, we always have our scrapbook.

About atomics, too—Now, at last, Oak Ridge is giving water works men a break, in diverting some of its energy toward the problem of predicting next year's water yield. Thus, the atomic furnaces are producing radioactive cobalt to be turned over to the weather bureau, which, in turn, is sinking 40-millicurie amounts of the material into the ground in aluminum boxes with a Geiger counter mounted on an elevated platform above each one of them to make a new type of snow-measuring device that will indicate mass rather than depth. Although still in the experimental stage, these installations give real promise of furnishing an accurate means of estimating future water supply—information which should be helpful even when discouraging. To Californians, for whom such information would have most significance, the boon of this Geiger counting is almost as nothing right now compared with the boom of Geiger counting 49'ers of this century who have struck it rich in "them thar same hills," striking a vein of rich uranium ore some 400 ft. long, 8 in. wide and of unknown depth. To even us, though, who, perhaps unfortunately, have more stake in the former than in the latter, this news of at least an effort at beneficence in radioactivity represents another split in the pervasive atomic gloom.

About divinity—The resurrection of the dowser, or at least the dowsing dithers, in the dignified pages of the *Journal N.E.W.W.A.* certainly calls for comment; for even if its serious review of the subject has taken us no nearer a comfortable conclusiveness, we must confess to a certain jealousy at being scooped on the use of such various witch wands as buggy whips,

(*Continued on page 6*)



the facts reveal how Ozone solved an outstanding water problem

A typical industrial city, with an especially difficult water problem, Whiting, Indiana, will soon complete its 10th year of successful taste and odor control with Ozone.

This Welsbach-Ozone system was installed after all other attempted methods failed to produce a palatable water.

Now, after a decade of actual experience with Ozone, consumers and officials alike agree that the problem has been overcome.

To consumers, the Welsbach-Ozone installation has brought a water supply free of undesirable characteristics.

For operators of the Whiting plant, the Welsbach-Ozone installation has performed with high efficiency and low cost. The Welsbach unit at Whiting has a capacity of 3 mgd with an average flow of 2 mgd. Carefully-maintained records indicate an approximate operating cost for Ozone of only $2 per 1,000,000 gallons—in a situation that has been described as the worst raw water condition in the United States!

If taste, color or odor are involved in your city's water problems, Ozone may be the effective, economical answer. Your inquiry to The Welsbach Corporation will bring you prompt information without obligation on your part.

THE WELSBACH CORPORATION

OZONE PROCESSES DIVISION

1500 Walnut Street Philadelphia 2, Pa.

(*Continued from page 4*)

sieves and corset stays. And to the anecdotal discussion which followed Lincoln Ryder's presentation of the review, we should append the recent incident at Potschefstroom (honest!), South Africa, where still another dowser contributed to the general confusion by directing a well driller's bit into the main supply line from the town's reservoir. Wherever we turn these days, we seem destined to encounter divining in one form or another, our alleged allergy to rhabdomaniacs notwithstanding.

And so on, ad museum—

Even our correspondence this month has been unusually productive of the wherewithal of musery. From the L. J. Bordo Co., whose trade symbol is a defiant "B'O," we received an eyebrow-raising inquiry for information on quick sand filter plants. From the Robert W. Hunt Co., not long before Thanksgiving, we had a promotional proposal signed by none other than Myles Standish, dictated this time to someone initialed "M.O.," John Alden having evidently spoken for himself just once too often. And on a note from the Stuart Corporation, we spotted a letterhead advertisement for "Waterman Cleaning and Lining," which seemed to us closer to pens than penstocks, but may well refer to one of Fred's follow-ups to his earlier pH-controlled whisky. At any rate, not having time ourself to meditate, we felt obliged to offer this report for your own musement.

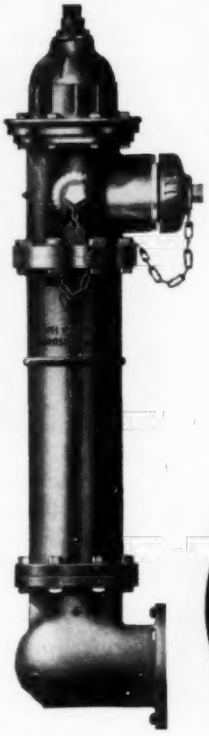
Even in Dutch, men muse, and come out with pretty much the same music as we do here. Only last September 7, for instance, our counterpart, "Aquarius" in the Netherlands' journal, *Water,* mastermused a skit, which not only proves our present point but evidences the real identity of problems faced by water works men wherever. In free translation, by Prof Willem Rudolfs of Rutgers, the plaint of "Aquarius" sounds more than a little familiar:

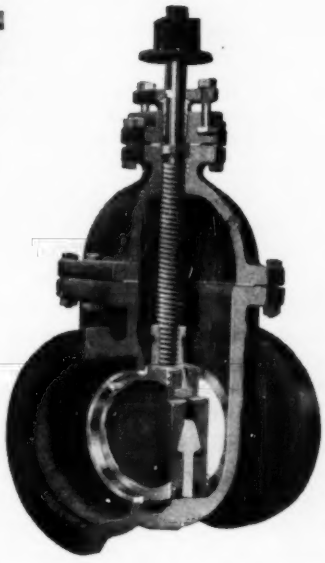
> Sitting in overstuffed chairs, my friend—the important business man—and I—the water supply man—were pleasantly chatting about the price relations, earnings, methods, and so on of big business. He is a fine man, and a pretty clever one. He told me what was cooking in the business kitchen, and the longer he talked, the more my inferiority complex increased. In the end, feeling very small, I told him, with even more modesty than water works engineers usually, by nature, assume, what is going on in our business. When I finished, he said, "You are in effect a big business man; but tell me, what do you get out of it?"
>
> "Oh," I said, somewhat timidly, "let's not talk about that. For us public servants, monetary rewards are secondary. We rarely can, sometimes just manage, but usually cannot make ends meet. But you should not forget that we don't have to pay as large taxes as you; and consider how much it is worth to serve the public. That is an exalted privilege, more valuable than the money

(*Continued on page 8*)

for BETTER SERVICE *Use* M & H

Hydrants, Valves
and pipe line accessories





Hub Ends, Mechanical Joint, Flanged or Screwed.

●

M & H Products Include—

FIRE HYDRANTS
GATE VALVES
TAPPING VALVES
WALL CASTINGS
SPECIAL CASTINGS
TAPPING SLEEVES
CHECK VALVES
FLOOR STANDS
EXTENSION STEMS
SHEAR GATES
MUD VALVES
VALVE BOXES
FLAP VALVES
SLUDGE SHOES
FLANGE AND FLARE FITTINGS
FLANGED FITTINGS
B & S FITTINGS
CUTTING-IN TEES

VALVES: A.W.W.A. type, iron body, bronze mounted with double disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position. All rugged and dependable, made of best material with highest quality workmanship.

HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals. Dry top, revolving head, easy to lubricate. High efficiency because barrel diameter not reduced and there are no working parts or obstructions in waterway.

FOR WATER WORKS AND SEWERAGE WORKS MATERIALS, WRITE FOR CATALOG NO. 32.

FOR FIRE PROTECTION MATERIALS, WRITE FOR CATALOG NO. 40.

M & H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

(*Continued from page 6*)

you need to make ends meet. You big business artists have no conception how happy a man is when he considers his salary as secondary."

My friend looked at me with compassion and said: "But what about the price of your product? You water people are really idiots in that respect. Who is so stupid to sell a product absolutely essential to everybody and on which he has a monopoly for maybe as little as a dime a ton, deliver it to the customers any time during night or day, no matter how far they live from the factory. Don't you understand that, psychologically, it is crazy to set a price per ton, per 1,000 or even per 1,000,000 gals.? Sell your product for ⅛ of a cent a gallon and nobody will quibble, but if you increase the price from a dime to a quarter a ton, all the papers will be shouting about the robbery. You people have not the slightest notion of the psychology of selling. Other big business men in your own line know better. Look at those selling ice—prime quality water from the tap. This frozen water, delivered, may cost as much as 50¢ a hundred pounds, or 100 times more than you get. It is better yet to put in some carbon dioxide, then you'll get 1,000 times more than you ask for the same product without the CO_2. Other possibilities should not be overlooked. Take some brackish water: if it contains too much salt, add some tap water, charge it with some CO_2, put it into small bottles, and sell it as fine table water for $150 a ton, or 1,500 times your price. The people will yell for it, especially if it contains about 950 ppm. chlorides. Simpler and more lucrative is specialization in imitation-real-spring water; put on the label 'mineral content in composition similar to the original,' sell it under a fancy name and charge, say, 50¢ a bottle. This will bring you about 6,000 times what you get now. The public will love it."

With increased enthusiasm, my friend said: "The height of idiocy is your frequently used method of charging on all kinds of bases rather than on the actual amount of product delivered, and the often outdated methods of collection."

Slowly, I acquired the mood of a boxer beginning to feel punch-drunk. With a last effort I said: "Thanks for your compliments. I can imagine that you, with your psychological approach to making money, cannot understand our ethical methods. You don't seem to understand that ideological motives form the basis of our business and that we serve the public rather than exploit it."

"My friend," he said, "our chat is getting disagreeable, but I want to tell you that your ideological concepts are not appreciated by the public; they regard you as first-class robbers." I took another drink, went home giddy from the drinks and the mental shower and saw the following in an American magazine:

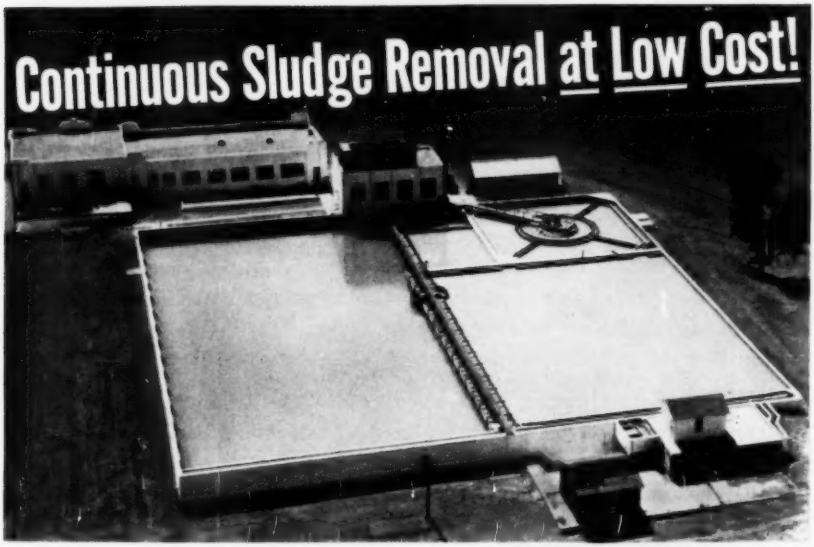
"Garbage, generally considered the cheapest material, handled under the most favorable conditions and with the most modern equipment, cannot be dug and loaded in carts for the price for which water is collected, treated, pumped and distributed, to be always and immediately available in any desired quantity for each consumer wherever he wants it."

That was the limit; I went to bed.

Chester P. Gabosch has been appointed sales manager of M & H Valve & Fittings Co., Anniston, Ala.

(*Continued on page 10*)

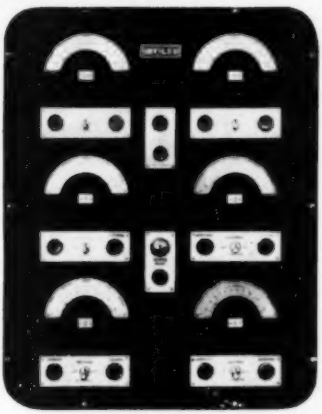
Continuous Sludge Removal at Low Cost!



Water Treatment Plant . . . Muskogee, Okla.

ACCELATOR®

With Infilco PUSH BUTTON FILTER CONTROL Gives Muskogee Greater Capacity in Far Less Space!



An ACCELATOR only *70 feet square* softens and clarifies TWICE as much river water for Muskogee, Okla., as the former method did in a space 210 feet square! Extreme flexibility of operation with a remote push button filter control system centralized on one panel, is a feature of this highly satisfactory installation. The flow through all filters is maintained at a uniform rate and increased or decreased as desired by simply pressing the proper button!

ACCELATORS invariably give simpler operation, faster chemical reaction, higher ratings and an exclusive slurry recirculating feature which produces better, clearer water in less time. They can effect up to *80% savings in space!* Mixing, coagulating, settling, and sludge removal . . *all* these operations are replaced in ONE COMPACT UNIT! ACCELATOR installations are now economically treating over *One Billion* Gallons of water daily. Get all the facts. Send for our new 28 page bulletin No. 1825. Write today!

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 •

INFILCO INC.

GENERAL OFFICES: 325 WEST 25th PLACE • CHICAGO 16, ILLINOIS

SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

(*Continued from page 8*)

Peter Diederich, general manager and chief engineer of the Glendale, Calif., Public Service Dept., died on November 1, at the age of 68. He became superintendent of construction and operation of the infant department in 1909, when it provided electricity to 190 customers in a community of 2,500. He grew with the town, which enlarged the area of its needs rapidly. In 1913 the water system was acquired, and six years later he became head of the combined water and electric departments. Always looking to the future, he was active in the formation, around 1930, of the famed Metropolitan Water District, which brought Colorado River water into Southern California. He made it a community boast that Glendale has the second lowest water rate for cities of its size—104,000—in the nation, and the fourth lowest rate for electricity.

Clarence B. Hoover, superintendent of the Columbus Division of Water, died November 5 after a heart attack. He had been in the service of the city for 45 years, and had been superintendent for over 25. Recently the city decided to name a new construction over Big Walnut Creek as Hoover Dam, in honor of both Clarence B. and his brother Charles P. Hoover, the noted chief chemist of the city's filtration plant.

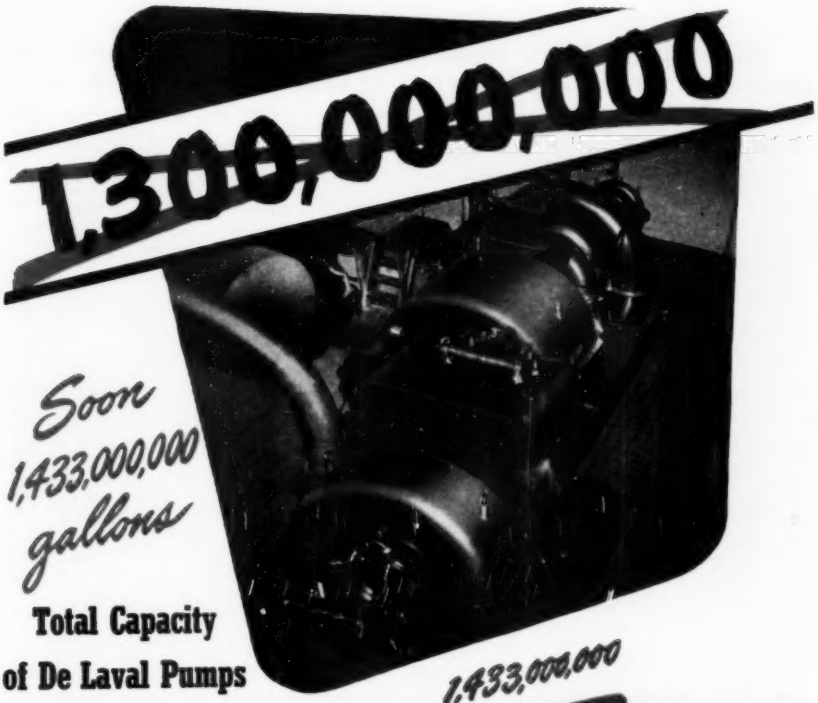
Henri K. Jordan, president and general manager of Canada Valve and Hydrant Co., Brantford, Ont., died on October 27 after a week's illness. Known primarily to his colleagues in the water works field as an industrialist, Dr. Jordan also had an international reputation as a musician, having organized the Schubert choir, which received wide acclaim during the years from 1906 to 1941. He was also an organist, composer and conductor.

"Municipal Sewer Ordinances"—third of a series of special manuals of practice produced by the Federation of Sewage Works Assns., 325 Illinois Bldg., Champaign, Ill., has just appeared and is being sold at $1.00 per copy. The 44-page manual includes a "model" form of ordinance and illustrates suggested permit forms which could be used to supplement the ordinance.

"Applied Hydrology," by Weather Bureau experts Linsley, Kohler and Paulhus, offers a detailed exposition of the techniques for computing and forecasting runoff and stream flow, with a summary chapter on water supply forecasting. About 700 pages, abundantly illustrated. McGraw-Hill Book Co., $8.50.

Water Works Service Co., Inc., is moving to 121 South Broad St., Philadelphia, from its present offices at 50 Broad, New York. The organization furnishes engineering, accounting, purchasing, executive and administrative services to the 129 subsidiaries, in 21 states, of the American Water Works Co., Inc., and Northeastern Water Co.

(*Continued on page 12*)



Soon 1,433,000,000 gallons

Total Capacity of De Laval Pumps in the City of Chicago... ~~1,300,000,000~~ 1,433,000,000 Gallons Daily

In the year 1920, the City of Chicago installed its first turbine-driven centrifugal pump—a unit of 60 mgd capacity in the Central Park Station. The performance, trouble-free operation, economy and flexibility of this unit proved to be so satisfactory that additional De Laval turbine-driven pumps were installed in rapid succession.

Today, the City of Chicago is served by a total of 16 De Laval turbine-driven pumps and 5 De Laval motor-driven pumps having a total capacity of one billion, three hundred million gallons daily.

Send for Catalog 10-7-JA

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

P.S. The City of Chicago ordered two more De Laval Turbine Driven Pumping Units soon after the above ad was written. These units will increase the total capacity of De Laval waterworks pumps in that city to 1,433,000,000 gallons daily.

(*Continued from page 10*)

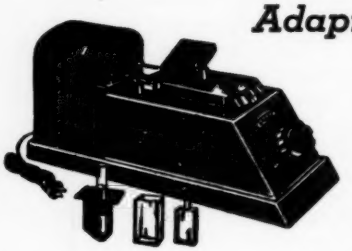
National Anti-Week Week, sponsored by our own Society for the Restoration and Preservation of the 52-Week Year, just didn't work. Where there were 200-plus "weeks" of major and minor consequence two years ago, there must be at least 300 now, the antagonism of our one-man society to the contrary notwithstanding. Thus, we're disbanding the old club and asking its membership to sign up now in a new organization, the purpose of which will be to obtain for the water works man his proper share of the years to come. Having in the last month observed, if not actively participated in, such *major* celebrations as Apple Week, Better Parenthood Week, Children's Book Week, Girl Scouts Week, Hearing Week, Honey (type bee) Week and Postwar Prosperity Week, and getting ready now for International Golden Rule Week, we can see no reason why our new Organization for the Establishment and Observance of Water Supply Week shouldn't get almost immediate action. So with our sights set on the last week in March, which will, of course, include A.W.W.A.'s birthday, we're accepting applications now. Let's make O.E.O.W.S.W. our middle initials!

P.S. If sewage works men want a week, too, the logic of our flow chart would recommend the week following.

(*Continued on page 16*)

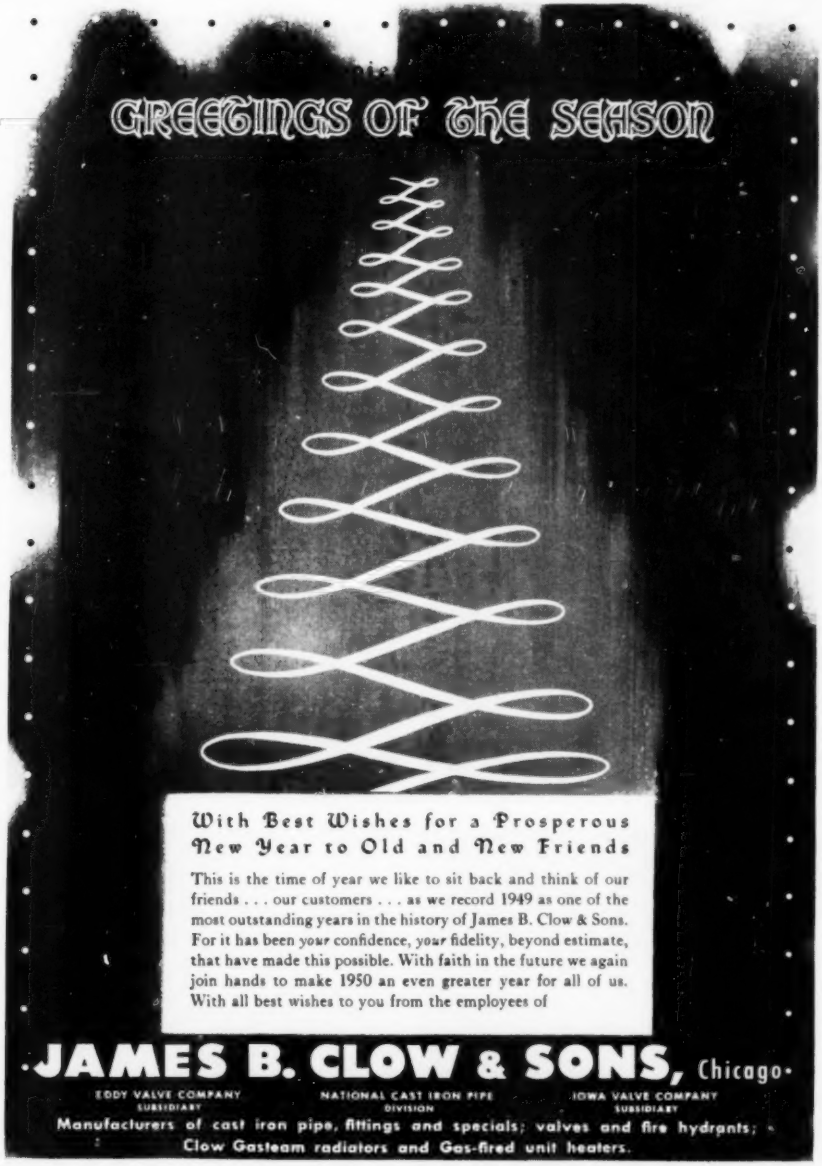
KLETT SUMMERSON
ELECTRIC PHOTOMETER

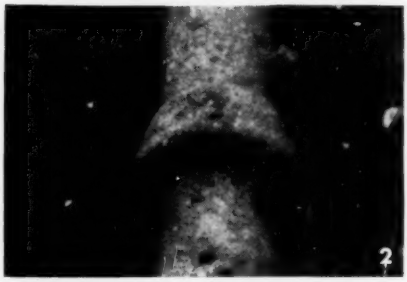
Adaptable for Use in Water Analysis



Can be used for any determination in which color or turbidity can be developed in proportion to substance to be determined

KLETT MANUFACTURING CO.
179 EAST 87th STREET · NEW YORK, N. Y.


GREETINGS OF THE SEASON
With Best Wishes for a Prosperous New Year to Old and New Friends
This is the time of year we like to sit back and think of our friends . . . our customers . . . as we record 1949 as one of the most outstanding years in the history of James B. Clow & Sons. For it has been your confidence, your fidelity, beyond estimate, that have made this possible. With faith in the future we again join hands to make 1950 an even greater year for all of us. With all best wishes to you from the employees of
JAMES B. CLOW & SONS, Chicago
EDDY VALVE COMPANY SUBSIDIARY
NATIONAL CAST IRON PIPE DIVISION
IOWA VALVE COMPANY SUBSIDIARY
Manufacturers of cast iron pipe, fittings and specials; valves and fire hydrants; Clow Gasteam radiators and Gas-fired unit heaters.



(1) This 101-year-old cast iron water main is serving Frederick, Maryland.

(2) Still in use after 118 years of service in the water supply system of St. Louis, Mo.

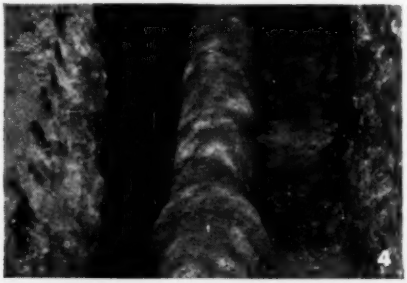
(3) This water main, installed 117 years ago, is still serving Richmond, Va.

(4) Lancaster, Pa. laid this cast iron water main 105 years ago. It is still serving.

(5) One of several cast iron water mains that have been serving New York City for more than a century.

(6) America's oldest cast iron water main, now in its 128th year of service in Philadelphia.

(7) This cast iron water main has been serving Boston for 120 years.



CAST IRON PIPE

Going strong in their 2nd Century

About 30 of the older American cities have cast iron water or gas mains in service which were laid from 100 to 132 years ago. Most of these mains, on or after their 100th Anniversary, have been uncovered, inspected and photographed for the record. Seven of them—all water mains, are shown in this advertisement.

While it is well known that cast iron water mains in England, France and Germany have service records that approach three centuries, we, who make cast iron pipe, nevertheless get a thrill out of looking down into the trench at an uncovered section of a main that has been in service for 100 years—and so, we are told, do water works and gas engineers.

When one considers the radical changes which have occurred in a century in vehicular traffic, and the vast development of underground construction for the many utility services, the fact that these mains are now in their second century of service is all the more remarkable. Cast Iron Pipe Research Assn., T. F. Wolfe, Engr., Peoples Gas Bldg., Chicago 3.

SERVES FOR CENTURIES

(*Continued from page 12*)

An indexed review of research being conducted at engineering colleges and universities has been published by the Engineering College Research Council of the American Society for Engineering Education. A directory of 82 member institutions and their research programs, conferences and short courses is included. Copies of the paper-bound volume are available at $1.75 each from F. M. Dawson, council chairman, at the College of Engineering, State University of Iowa, Iowa City, Iowa.

Harvey F. Ludwig of Ludwig Bros. Engineers, Pasadena, Calif., has been appointed associate professor of sanitary engineering at the University of California at Berkeley. Ludwig Bros. Engineers continues with three active partner-brothers—John, Gordon and Russell—instead of four, but Harvey will continue his association with the firm as consultant on specialized sanitary engineering problems.

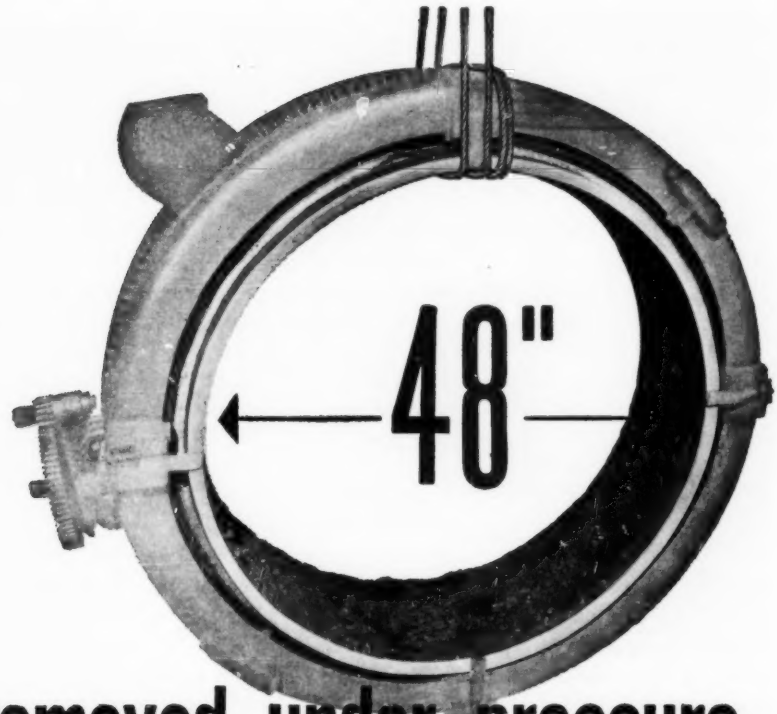
R. A. Bardwell, chemical engineer, has been appointed to the newly created position of engineer of tests for the Chicago & Eastern Illinois Railroad, with headquarters at Danville, Ill. A graduate of the University of Florida, where he studied under Dr. A. P. Black, he has been employed in the railroad department of the National Aluminate Corp. A.W.W.A. membership lists now contain two Bardwells who are railroad men—R. C. continuing as superintendent of water supply for the Chesapeake & Ohio line.

"Bill" Orchard, general manager of Wallace & Tiernan Co., has received the Charles A. Emerson Award of the Federation of Sewage Works Associations.

A new method of designing welded spherical tanks has been developed by Pittsburgh-Des Moines Steel Co. vice-president J. O. Jackson. The method reduces the amount of welding necessary and the scrap loss by assembling the tank from steel plates that are more nearly rectangular than has been possible with the "orange peel" or "longitude and latitude" layouts previously used. Determination of the most economical arrangement for the unconventional layout was made from a new research technique for predicting the displacement of flat materials which are to be bent or curved. The method consists in assembling a plastic replica of the curved object and then relaxing it to a flat surface by the application of sufficient heat.

A device which automatically feeds checks into a microfilming camera at the rate of 250 a minute has been developed by the Management Controls Div. of Remington Rand. The device will also handle cards ranging from 2½ to 10 in. wide.

(*Continued on page 18*)



removed under pressure

This pipe section was cut, under pressure, from a 48″ main without shut-down or other interruption to service. The operation was performed in the course of inserting a gate valve in a 48″ cast iron main, in the distribution system of the Water Bureau, City of Philadelphia, Pa.

Gate valves can be inserted under *pressure* by SMITH in cast iron, asbestos–cement or steel water mains, sizes 4″ and larger, without shutting off service or dewatering the line.

30

THE A. P. SMITH MFG. CO.
ESTABLISHED 1896
EAST ORANGE NEW JERSEY

(*Continued from page 16*)

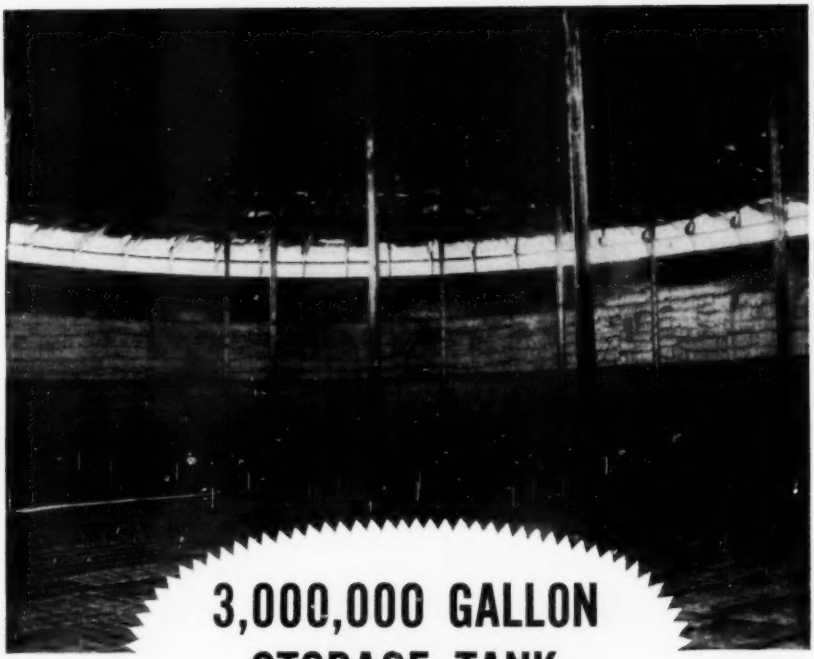
That flavor can be studied in profile is a new concept advanced by Arthur D. Little, Inc., Chemist-Engineers of Cambridge 42, Mass. We have long known, of course, that flavor is the name of the taste and odor problem in the field of other foods than water, but little have we realized the refinements of technique available to food technologists in studying the "ugh" and "pew" of material for ingestion. As a matter of fact, the Little analysis, by which a panel of sensitized mouthers and sniffers may individually and in seminar develop a diagram descriptive of flavor, is not only fascinating but of possible value to water works men. Just what the method involves can best be ascertained by requesting from the Little organization a copy of its booklet, "Flavor Profiles—A New Approach to Flavor Problems," S. E. Cairncross and L. B. Sjostrom, for our own preoccupation with the full significance of such terms as the "philosophy of seasoning" and "democracy of determining presence or absence of characteristic notes" destroys our reportorial accuracy. Besides, with perhaps good reason, you wouldn't believe us if we told you.

Caveat Salmonella! The New York State health laboratory has just been designated a regional salmonella center to collaborate with the world center at Copenhagen, Denmark, in the search for the many strains of the causative organism of typhoid and typhoid-like diseases. Identification and study of these various strains will of course provide a clue to their destruction or control, which will be of direct interest to water works men. But pending such definite knowledge, we bring the subject up primarily to introduce the culprit, *Salmonella typhosa,* which, on the authority of the 6th edition of *Bergey's Manual,* is the proper name for the causative organism of waterborne typhoid. Known generally in the water works field under such aliases as *Bacillus typhosus* and, more recently, *Eberthella typhosa,* or even *typhi,* this organism should be reindexed in your rogues' gallery. Not so much a matter of persnickitiness, proper terminology in this case should actually be helpful. After all, even a psychiatrist can tell a lot from family history.

Paul R. Carlon has been appointed chief engineer of the Calmet Water Meter Div. of Well Machinery and Supply Co., Inc., of Fort Worth, Tex. He had previously been with Rockwell Mfg. Co.

Hungerford & Terry of Clayton, N.J., has appointed the following representatives: Walton & Best, 320 Plymouth Bldg., Cleveland, Ohio, in portions of Ohio and Pennsylvania; Allan K. Cook Co., 505 S. 3rd St., Louisville, Ky., in Kentucky; C. J. Gaskell Co., 1007 Falls Bldg., Box 162, Memphis, Tenn., in portions of Tennessee and Arkansas; and Harold O. Knape, 308½ N. Harwood St., Dallas, Tex., in northeastern Texas.

(*Continued on page 20*)



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(*Continued from page 18*)

Thanksgiving, just passed in a boneyard full of turkey skeletons, is something else again in Stoney Middleton, Derbyshire, England. Not just something else because it comes in August either, but something of special significance to water works men. For the Stoney Middleton Thanksgiving, called Well-Dressing Day, is a day of thanks for pure water, and, when it is considered that the entire populace of the village spends months in planning and preparing its well dressings, the sincerity of the thanks ought to be evident.

Actually, the dressing which Stoney Middleton's well gets as a thank you for providing water is made up of religious pictures laboriously created out of fresh flowers, mosses, cones, haricot beans, bark, lichens and clay, collected, prepared and worked into a prepared board pattern by hundreds of volunteers. And though the masterpieces fade soon after they are erected, all the more proof that the efforts are spent for thanks rather than reward. Would that some of our own consumers might consider even a tap-dressing day on which to decorate their plumbing fixtures with new washers.

An electric logging device for water wells has been designed in portable form by the instrument division of Carl A. Bays & Assoc., geological and geophysical engineering firm. The unit, which may be carried in an ordinary passenger car, consists of two parts, the reel with logging line, electrode and depth-measuring counter, and the measuring instrument in a portable case. The logs obtained provide useful data on new wells to guide their completion, and the device has been used in both cased and uncased old holes for repair work. Further information available from the firm at Box 189, Urbana, Ill.

A portable potentiometer designed for corrosion field work has been produced by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. The multirange instrument makes it possible to obtain accurate readings quickly when investigating galvanic and electrolytic action along pipelines and other buried metallic structures.

Graver Water Conditioning Co. has moved to larger quarters at 216 W. 14th St., New York 11. The new location houses sales and engineering, a laboratory and an extensive pilot plant.

The Superheater Co., Ltd., of Montreal, Que., together with its affiliate, Combustion Engineering Corp., Ltd., has been appointed to represent the De Laval Steam Turbine Co. of Trenton, N.J., in Quebec, Newfoundland and the Maritime Provinces.

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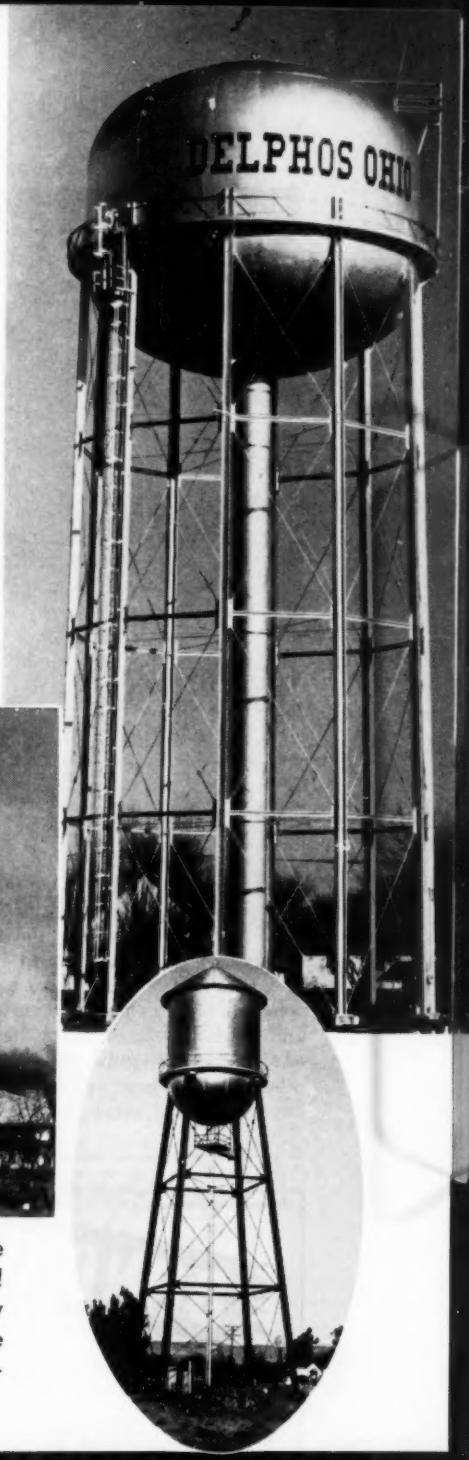

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Picks Pix

To the Editor:

I have been rather interested in the box score of the "likes and no likes" as regards the pictures on the cover of the JOURNAL. I would very much like to add my two bits' worth in favor of the pictures. As a member of the American Society of Civil Engineers I receive both the *Proceedings* and *Civil Engineering*. *Proceedings*, as you probably know, comes in a plain gray cover with simply the name. On the other hand, *Civil Engineering* has a picture of some engineering project and, in my estimation, adds considerably to the interest of the magazine. The *Journal of the American Chemical Society* lists the contents on the cover as our own JOURNAL used to do.

A long list of papers and authors is somewhat disturbing, to me at least, and appears to accentuate the dryness of a scientific publication. On the other hand, those publications which have a picture seem to give promise of more interesting material inside. The modern trend in many publications seems to be to have pictures on the cover. In fact, most of our popular novels and other literature today have a paper cover over the cloth binding. This paper cover, as you know, contains more or less pictorial material and makes a book much more interesting, I am sure, than if there was merely the cloth cover with the name stamped thereon.

As far as I am concerned, you may count me as 100 per cent for your new cover, and I would be very much opposed to going back to the old type and using it as a table of contents.

RAY L. DERBY

Prin. San. Engr.
Dept. of Water & Power
Los Angeles, Calif.; Nov. 14, 1949

This last word before a New Year's cover leaves us still in doubt. There'll probably be a change—but to what? —ED.

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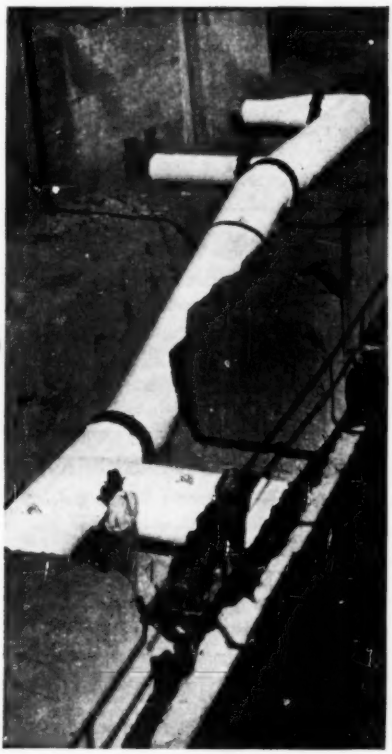

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Membership Changes

NEW MEMBERS

Applications received October 1 to 31, 1949

Adrian, George W., Civ. Eng. Assoc., Dept. of Water & Power, 410 Ducommun St., Los Angeles 12, Calif. (Oct. '49)

Albert, Charles A., Jr., Asst. Engr., Maint. & Operation Dept., Washington Suburban San. Com., Hyattsville, Md. (Oct. '49) *M*

Amawalk-Shenorock Water Dist., Alfred Beyrodt, Secy., Shenorock, N.Y. (Corp. M. Oct. '49)

Annen, Robert C., Asst. Chief Engr., Winthrop-Stearns, Inc., Rensselaer, N.Y. (Oct. '49) *MP*

Arcade, Village of, John C. Wise, Supt. of Public Works, 17 Church St., Arcade, N.Y. (Munic. Sv. Sub. Oct. '49) *M*

Asbury, W. D., *see* El Paso County Water Control & Improvement Dist. No. 1

Barker, Joe, Maint. & Operation, Filter Plant, 427 S. Madison Ave., Irvine, Ky. (Oct. '49) *P*

Barnes, W. Frank, Dist. Mgr., Peoples Water Service Co., Corinth, Miss. (Oct. '49) *MP*

Barrow, Joe, Chief Chemist, Water & Sewage Treatment, Water & Sewage Dept., Box 72, Tullahoma, Tenn. (Oct. '49) *MP*

Beauchamp, Frank D., Pumphouse Operator, Fibreboard Products, Inc., Antioch, Calif. (Oct. '49) *MPR*

Benson, Walter, Constr. Supt., B & M Constr. Co., 316 Petroleum Bldg., Oklahoma City, Okla. (Oct. '49)

Beyrodt, Alfred, *see* Amawalk-Shenorock Water Dist.

Blais, Marcel, Operator, Canadian Celanese, Ltd., Drummondville, Que. (Oct. '49)

Bly, Homer B., Supt. & Acting Mgr., Water Works, Plano, Tex. (Oct. '49)

Bowen, J. H., *see* Lake George, Village of

Bowie, Washington, Engr. of Water Design, Baltimore County Metropolitan Dist., Towson 4, Md. (Oct. '49) *M*

Breedlove, H. E., Public Health Engr., Mobile County Board of Health, Box 489, Mobile 3, Ala. (Oct. '49)

Buffington, L. I., Water Supt., City Water Works, Box 166, Jal, N.M. (Oct. '49)

Cannon, Mallory K., Jr., Sales Engr., General Electric Co., 200 S. Tryon St., Charlotte, N.C. (Oct. '49)

Carmichael, George Thomas, Asst. San. Engr., State Board of Health, Jackson, Miss. (Oct. '49) *M*

Chemical Fire & Rust Proofing Corp., Kurt A. Gruber, Secy., 508 E. 117th St., New York 35, N.Y. (Assoc. M. Oct. '49)

Clifford, Robert Keaney, Civ. Engr., Div. of Budget, Section of Institutional Eng., State of Virginia, 4702 Eastover Ave., Richmond 23, Va. (Oct. '49)

Clift, Mortimer A., Sales Agent, 815 Berkley Rd., Indianapolis 8, Ind. (Oct. '49) *P*

Cloyd, Ivan, *see* Normal, Town of

Coe, James G., Supt., Water Plant, Jamestown, N.D. (Oct. '49) *MP*

Cole, T. A., Supt., Meter Dept., Midland, Tex. (Oct. '49)

Costantinou, Costos E., Chemist, Corps of Engrs., Washington Dist., Dalecarlia Filtration Plant, 5900 MacArthur Blvd., Washington, D.C. (Oct. '49) *P*

Crachi, Domenico, Jr., Civ. Engr., 142 Ontario Ave., Massapequa, N.Y. (Oct. '49) *R*

Craft, John A., *see* Montauk Water Supply Corp.

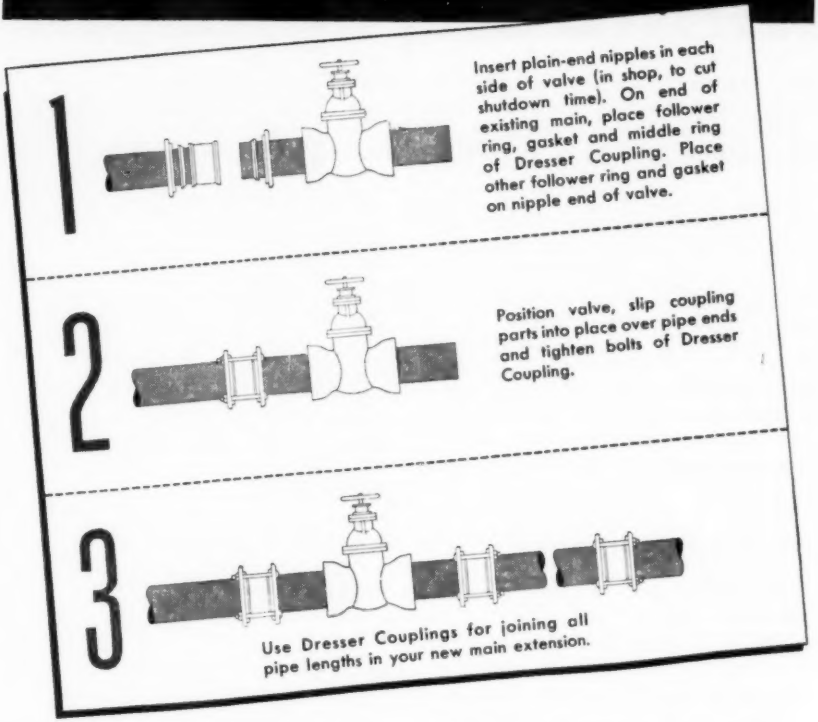
Crawford, Perry, *see* Lake Worth, City of

Dewey Bros., Inc., W. R. Helms, Purchasing Agent, Box 555, Goldsboro, N.C. (Assoc. M. Oct. '49)

Dickson, Frederick J., Civ. Engr., New York City Dept. of Water Supply, Gas & Elec., 3201 Atlantic Ave., Brooklyn, N.Y. (Oct. '49) *MPR*

(*Continued on page 30*)

IDEAL WAY to extend a main


1
Insert plain-end nipples in each side of valve (in shop, to cut shutdown time). On end of existing main, place follower ring, gasket and middle ring of Dresser Coupling. Place other follower ring and gasket on nipple end of valve.
2
Position valve, slip coupling parts into place over pipe ends and tighten bolts of Dresser Coupling.
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(*Continued from page 28*)

Direction Generale des Services Hydrauliques, Joseph N. Lanoix, Directeur General, Rue des Miracles, Port-au-Prince, Haiti (Corp. M. Oct. '49) *MPR*

Ellingwood, Richard E., Pres. & Mgr., Soft Water Service Co., 619 N. Monroe St., Spokane, Wash. (Oct. '49) *P*

El Paso County Water Control & Improvement Dist. No. 1, W. D. Asbury, Gen. Mgr., Ysleta, Tex. (Corp. M. Oct. '49)

Engel, Robert C., *see* Horne, George R., & Co.

Ewbank, Norman M., Jr., Sr. San. Chemist, Water Safety Control Section, 3300 E. Cheltenham Pl., Chicago 49, Ill. (Oct. '49) *P*

Fifer, George F., Supt., McMillan Filter Plant, Washington Aqueduct, 1st & Douglas Sts., N.W., Washington 25, D.C. (Oct. '49) *MP*

Finn, Raymond, General Foreman, Water Dept., Euclid Ave. & Lake St., Oak Park, Ill. (Oct. '49) *M*

Fortson, Eugene P., Jr., Chief, Hydraulics Div., Waterways Expt. Station, Vicksburg, Miss. (Oct. '49)

French, A. R., *see* McKesson & Robbins, Inc.

Gall, John F., *see* Lake City, City of

Glasser, C. E., General Reduction Co., 330 S. Dearborn St., Chicago 4, Ill. (Oct. '49)

Gloyna, Earnest F., Asst. Prof., Univ. of Texas, 150-H Engr. Bldg., Austin, Tex. (Oct. '49) *MPR*

Goldman, Otis, Mgr., Falfurrias Water Co., Box 218, Falfurrias, Tex. (Oct. '49) *M*

Goudy, Maynard P., Western Dist. Supervisor, Arizona Edison Co., Box 311, Yuma, Ariz. (Oct. '49) *M*

Gould, Seymour M., Civ. Eng. Asst., Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles 54, Calif. (Oct. '49)

Grady, J. R., Supt., Water Dept., 1011 College St., Bowling Green, Ky. (Oct. '49)

Gruber, Kurt A., *see* Chemical Fire & Rust Proofing Corp.

Grune, Werner Norbert, Research Assoc., L. V. Carpenter Lab., 12 Lynn Court, Rutherford, N.J. (Oct. '49) *PR*

Gruss, John G., Civ. Engr., Albright & Friel, Inc., 121 S. Broad St., Philadelphia 7, Pa. (Oct. '49) *PR*

Harbert, John M., III, Pres. & Civ. Engr., Harbert Construction Corp., 2337—20th Ave., S., Birmingham 9, Ala. (Oct. '49) *PR*

Harrell, Guy B., Hydr. Engr., U.S. Geological Survey, Box 607, Ocala, Fla. (Oct. '49)

Harvey, Eugene Callan, Sr. Draftsman, Bureau of Water Supply, Municipal Bldg., Baltimore 2, Md. (Jr. M. Oct. '49) *M*

Heald, Leslie E., Supt., Water Works, West Burlington, Iowa (Oct. '49)

Hefling, A. W., Cons. Engr., 209 W. 23rd St., Hutchinson, Kan. (Oct. '49)

Heger, Harold H., Engr., Boyd Phelps, Inc., 5350 Southeastern Ave., Indianapolis, Ind. (Oct. '49) *MPR*

Helms, W. R., *see* Dewey Bros., Inc.

Hermel, V. J., *see* Western Metal Products Co.

Hewitt, William G., Sr. Engr., Bureau of Water Supply, 506 Municipal Bldg., Baltimore 2, Md. (Oct. '49) *M*

Hoffman, Charles A., *see* Madison Municipal Water Works

Holly Hill, City of, Lawrence O. Upson, Holly Hill, Fla. (Corp. M. Oct. '49) *MP*

Horne, George R., & Co., Robert C. Engel, 22187 Michigan Ave., Dearborn, Mich. (Assoc. M. Oct. '49)

House, Page H., Sales Engr., Wichita Pump & Supply Co., 935 Porter, Wichita, Kan. (Oct. '49) *R*

Hutchens, R. C., Supt., Water Works, 411 Norman St., Fulton, Ky. (Oct. '49)

Ingram, Jerald, Asst. County Engr., Pinal County Eng. Dept., Florence, Ariz. (Oct. '49)

Johnson, Baker C., Jr. Asst. Supt., Services & Records, Bureau of Water Supply, 504 Municipal Bldg., Baltimore 2, Md. (Oct. '49) *M*

Johnson, Karl Arthur, San. Eng. Asst., Dept. of Water & Power, 207 S. Broadway, Los Angeles, Calif. (Oct. '49)

Jones, Dewey, Supt., Water Dept., Murray, Ky. (Oct. '49)

Jones, J. W., Jr., J. W. Jones Co., Inc., 425 S. State St., Indianapolis, Ind. (Oct. '49) *MP*

(*Continued on page 32*)

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(*Continued from page 30*)

Jones, J. W., Sr., Pres., J. W. Jones Co., Inc., 425 S. State St., Indianapolis, Ind. (Oct. '49) *MP*

Kendall, David A., Asst. Head, Water Supply & Sewage Treatment Section, Bureau of Yards & Docks, Navy Dept., Washington 25, D.C. (Oct. '49)

Kennedy, I. B. (Mrs.), Clerk, Augusta County Board of Supervisors, Box 604, Staunton, Va. (Oct. '49)

Kerr, Joseph P., Supervisor, Tabulating Equip. Operations, Water Dept., 215 W. Broadway, Long Beach 2, Calif. (Oct. '49)

Kramer, Ralph, Well Driller, Kramer Bros., 15817 Loomis St., Harvey, Ill. (Oct. '49)

Lake City, City of, John F. Gall, City Clerk & Auditor, Lake City, Fla. (Munic. Sv. Sub. Oct. '49) *MP*

Lake George, Village of, J. H. Bowen, Supt., Water Dept., Lake George, N.Y. (Munic. Sv. Sub. Oct. '49) *MP*

Lake Worth, City of, Perry Crawford, Mgr., Munic. Water Works, Lake Worth, Fla. (Corp. M. Oct. '49) *MPR*

Lancaster, Henry Hamilton, Water Plant Operator, West Texas Utilities Co., San Angelo, Tex. (Oct. '49) *P*

Lanoix, Joseph N., *see* Direction Generale des Services Hydrauliques

Lenhart, Burr, Head, Water Supply & Sewage Treatment Section, Bureau of Yards & Docks, Navy Dept., Washington 25, D.C. (Oct. '49)

MacLean, Gordon E., Sales & Service, Dearborn Chemical Co., 918 Brownlee Rd., Memphis, Tenn. (Oct. '49)

Madison Municipal Water Works, Charles A. Hoffman, Chairman, Board of Public Works, Madison, Ind. (Corp. M. Oct. '49)

McCall, T. J., *see* Plant City, City of

McCarthy, E. J., Pres., Ed. A. McCarthy & Son, Inc., Munic. Sewage Plant Project, Madison, Ind. (Oct. '49)

McFarland, John W., Mgr., Control Div., East Bay Munic. Utility Dist., 512—16th St., Oakland 4, Calif. (Oct. '49)

McIlroy, Malcolm Strong, Prof. of Elec. Eng., Cornell Univ., Ithaca, N.Y. (Oct. '49) *M*

McKesson & Robbins, Inc., A. R. French, Mgr., Industrial Chem. Dept., 4th & Valley Sts., Burlington, Iowa (Assoc. M. Oct. '49)

McKibbin, Clifford, Jr., *see* Sanford, City of

Miller, David R., San. Engr., 9th Naval Dist., Quarters 10, NTC, Great Lakes, Ill. (Oct. '49) *MP*

Miller, Howard D., Plant Supt., Board of Public Utilities, 1302 E. Wood St., Paris, Tenn. (Oct. '49)

Mississippi State Rating Bureau, R. H. Tucker, Assoc. Mgr. & Chief Engr., Standard Life Bldg., Jackson, Miss. (Corp. M. Oct. '49)

Mitchell, Charles A., Dist. Repr., Calgon, Inc., Box 2406, Baton Rouge, La. (Oct. '49) *P*

Montauk Water Supply Corp., John A. Craft, Vice-Pres., Montauk, N.Y. (Corp. M. Oct. '49) *M*

Mount Dora, Town of, Harold D. Overhiser, Supt., Light & Water Dept., Mount Dora, Fla. (Corp. M. Oct. '49) *MP*

Murray, Lawrence W., *see* Rowat & Murray Engrs.

Murtaugh, L. F., *see* Trumansburg, Village of

Nelson, Morris O., Civ. Engr., J. P. Miller Artesian Well Co., 161 W. Wisconsin Ave., Milwaukee, Wis. (Oct. '49) *R*

Nicholls, Irvine L., Jr., *see* State Penitentiary Farm

Nichols, James S., Supt., Water Div., Dept. of Public Utilities, Colorado Springs, Colo. (Jan. '49) *M*

Nichols, Warren B., Assoc. Engr., Dept. of the Army, Corps of Engrs., 5900 MacArthur Blvd., N.W., Washington, D.C. (Oct. '49)

Normal, Town of, Ivan Cloyd, Water Works Supt., Normal, Ill. (Corp. M. Oct. '49) *MPR*

O'Neil, William James, Civ. Engr., Central Mortgage & Housing Corp., Vancouver, B.C. (Oct. '49)

Overhiser, Harold D., *see* Mount Dora, Town of

Painted Post, Village of, Board of Trustees, D. H. Seeley, Painted Post, N.Y. (Corp. M. Oct. '49) *M*

(*Continued on page 34*)

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(*Continued from page 32*)

Papp, Remig Anthony G., Civ. Engr., Malcolm Pirnie Engrs., 25 W. 43rd St., New York 18, N.Y. (Oct. '49) *MPR*

Pavanello, Renato P., San. Engr., United Nations, World Health Organization, Palais des Nations, Geneva, Switzerland (Oct. '49)

Pearcy, J. Hardin, Salesman, Neptune Meter Co., Box 47, Clermont, Ind. (Oct. '49) *P*

Pettit, W. L., Supt., Public Utilities, Weslaco, Tex. (Oct. '49) *MR*

Pfeiffer, F. R., Public Health Engr., State Dept. of Health, Dist. Health Service No. 10, Centerville, Iowa (Oct. '49) *MP*

Pittman, William G., Industrial Painting, William G. Pittman, 210 Main St., Hackensack, N.J. (Assoc. M. Oct. '49)

Plant City, City of, T. J. McCall, City Mgr., Plant City, Fla. (Munic. Sv. Sub. Oct. '49) *M*

Powers, Thomas J., Project Engr., The Dow Chemical Co., Midland, Mich. (Oct. '49) *PR*

Pride, Roland W., Hydr. Engr., U.S. Geological Survey, Box 607, Ocala, Fla. (Oct. '49)

Rast, F. S., Jr., Supt., Memphis Suburban Utility Dist., 655 Old Millington Rd., Memphis, Tenn. (Oct. '49) *MPR*

Rowat & Murray Engrs., Lawrence W. Murray, Partner, Old Bank Bldg., Belmond, Iowa (Corp. M. Oct. '49) *MPR*

Safford, Truman H., Engr., Charles T. Main, Inc., 80 Federal St., Boston 10, Mass. (Oct. '49) *PR*

Sanford, City of, Clifford McKibbin Jr., City Mgr., Sanford, Fla. (Corp. M. Oct. '49) *MP*

Schudel, Gustav W., Sr. Engr., Bureau of Water Supply, 508 Municipal Bldg., Baltimore 2, Md. (Oct. '49) *M*

Seeley, D. H., *see* Painted Post, Village of

Seymour, Raymond B., Tech. Director & Gen. Mgr., Atlas Mineral Products Co., Mertztown, Pa. (Oct. '49)

Smith, Dan R., Jr. Assoc. Engr., Baltimore County Metropolitan Dist., Towson, Md. (Oct. '49) *M*

Smith, J. Wilson, Asst. Water Registrar, Dist. of Columbia Govt., Washington, D.C. (Oct. '49) *M*

Spiegler, Kurt S., Head, Water Treatment Section, Israel Ministry of Agriculture, Hakirya, Tel Aviv, Israel (Oct. '49) *PR*

State Penitentiary Farm, Irvine L. Nicholls Jr., Filtration Plant Supt., State Farm, Va. (Corp. M. Oct. '49) *MP*

Steinmetz, George P., Chief Engr., Public Service Com., State Office Bldg., 1 W. Wilson St., Madison 2, Wis. (Oct. '49)

Stepp, W. H., Supt. & Filter Operator, Water & Sewer Dept., Kermit, W.Va. (Oct. '49) *MP*

Stravinski, Ceaser Anthony, Dist. San. Engr., State Board of Health, Box 269, Rhinelander, Wis. (Oct. '49) *P*

Theal, Alfred Robert, Civ. Eng. Asst., Dept. of Water & Power, 141 S. Everett, Glendale 5, Calif. (Oct. '49)

Thill, Stanley J., Civ. Engr. & Land Surveyor, Box 4, Conrad, Mont. (Oct. '49) *MP*

Traficanti, Nicholas, Pres., Desert Waters, Inc., 3118 E. Alvin Rd., Tucson, Ariz. (Oct. '49) *M*

Treat Eng. Co., Guy B. Treat, Pres., 208 Plaza Court, Oklahoma City, Okla. (Corp. M. Oct. '49) *MR*

Treat, Guy B., *see* Treat Eng. Co.

Trumansburg, Village of, L. F. Murtaugh, Water Comr., Water Dept., Trumansburg, N.Y. (Munic. Sv. Sub. Oct. '49) *MPR*

Tucker, R. H., *see* Mississippi State Rating Bureau

Upson, Lawrence O., *see* Holly Hill, City of

Vetromile, Daniel S., Sales Engr., Rockwell Mfg. Co., 1553 W. 7th Ave., Columbus 12, Ohio (Oct. '49)

Walters, Clyde L., Water Works Supt., Board of Public Affairs, Hebron, Ohio (Oct. '49) *M*

Wardrep, Jeter E., Jr., City Recorder, Jefferson City, Tenn. (Oct. '49)

Waterman, Walter Gilbert, Sr. San. Engr., State Water Power & Control Com., 90–79 Sutphin Blvd., Jamaica, N.Y. (Oct. '49) *R*

Watson, Vic, Owner, Catalina Water Co., 4249 E. Flower St., Tucson, Ariz. (Oct. '49) *MR*

Weems, William Jennings, Water Supt., Municipal Bldg., Temple, Tex. (Oct. '49)

(*Continued on page 36*)

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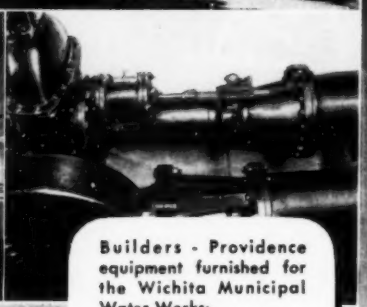

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(*Continued from page 34*)

Western Metal Products Co., V. J. Hermel, Pres., 611 New York Life Bldg., Minneapolis, Minn. (Assoc. M. Oct. '49)

Wex, Edward A., Sales Engr., Hydrite Chemical Co., 621 S. 12th St., Milwaukee 4, Wis. (Oct. '49)

White, Paul R., Cons. Engr., 505 Alameda, Muncie, Ind. (Oct. '49) *PR*

Wiest, J. Everett, Jr. Asst. Supt. of Constr., Bureau of Water Supply, 506 Municipal Bldg., Baltimore 2, Md. (Oct. '49) *M*

Wilcox, Roger F., Asst. Engr., Brown & Caldwell, 936 Norvell St., El Cerrito, Calif. (Oct. '49)

Winslow, K. M., Pres. Winslow-Light Construction Co., Salem, Ind. (Oct. '49)

Wise, John C., *see* Arcade, Village of

Wraight, Frank D., Asst. San. Engr., State Board of Health, 1700 N. Harrison St., Ft. Wayne, Ind. (Oct. '49)

REINSTATEMENTS

Bean, S. Karl, Resident Engr., Water Dept., Municipal Bldg., Oklahoma City 2, Okla. (Apr.' 46)

Kauffman, Winfield Scott, Sr. Asst. Supt. of Constr., Bureau of Water Supply, 506 Municipal Bldg., Baltimore 2, Md. (Oct. '42) *M*

Kinnear, Joseph Milton, Sr. Assoc. Engr. Bureau of Water Supply, Municipal Bldg., Baltimore 2, Md. (Jan. '42) *M*

Lacour, Leon, Supt., Water & Sewage Dept., 213 W. Oak St., Bunkie, La. (Oct. '43)

Wittichen, Carl F., Pres., Wittichen Chemical Co., 1609 S. 2nd Ave., Birmingham, Ala. (Jan. '48)

LOSSES

Deaths

Camp, Cecil S., Louisiana State Univ., 215 Atkinson Hall, Baton Rouge, La. (Apr. '46) *PR*

Goodell, Joseph Edward, City Chemist, Old City Hall, Box 457, Lancaster, Pa. (Apr. '24) *P*

Pollock, L. V., Resident Engr., Birmingham Water Works Co., Birmingham 3, Ala. (July '39) *M*

CHANGES IN ADDRESS

Changes received between October 5 and November 5, 1949

Angell, James M., Jr., Conover Mast Publications, Inc., 205 E. 42nd St., New York, N.Y. (July '35)

Art Concrete Works, Frank M. Brooks, 366 S. Fair Oaks, Pasadena 1, Calif. (Assoc. M. Dec. '20)

Asselstine, Erwin S., Geologist in Charge, U.S. Geological Survey, Ground Water Branch, Box 590, Albany, N.Y. (Oct. '47) *R*

Bell, William E., Inst. of Inter-American Affairs, Apdo. 23 Bis, Mexico, D.F., Mexico (Oct. '48)

Bendel, Harold W., R.D. 1, Box 352, S. Beverwyck Rd., Parsippany, N.J. (Jan. '48) *P*

Blaik, D. L., Pres. & Gen. Mgr., Leak Detector Co., 3391 Blanche Rd., Cleveland 18, Ohio (Apr. '39)

Brewster, John H., Dist. San. Engr., State Dept. of Health, 412 Rogers Bldg., Glens Falls, N.Y. (Jan. '47) *P*

Brisbane, Eugene C., 509 N. Bedford Drive, Beverly Hills, Calif. (Jan. '36)

Burt, Gordon L., San. Engr. & Supt., Sewage Treatment, 5000 N. Columbia Blvd., Portland 3, Ore. (Jan. '47) *M*

Charbonneau, Thomas F., 305 W. Colonial Drive, Orlando, Fla. (Jan. '45) *P*

Chun, William H., 1216 Kinoole St., Hilo, Hawaii (Jan. '49)

Cowan, John G., 1210 Monrado, Glendale 7, Calif. (Jan. '41) *R*

Curtis, John K., San. Engr., Dept. of Health, City Hall, Ottawa, Ont. (Apr. '46)

DeMartini, Frank E., U.S. Public Health Service, 819 Appraisers Bldg., 630 Sansome St., San Francisco 11, Calif. (Sept. '27) *PR*

Dierker, Fred H., 246 E. 18th St., Costa Mesa, Calif. (Oct. '42) *R*

Federick, Joseph C., State Dept. of Public Works, Div. of Highways, Utica, N.Y. (Jan. '46) *MP*

Flaa, Ingwald E., Hydr. Engr., 909 Carl Ave., Lafayette, Calif. (May '15)

(*Continued on page 38*)

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(*Continued from page 36*)

Forbes, H. de B., Jr., Lt.Col., Air Installations Div., Headquarters SAC, Offutt AFB, Omaha, Neb. (Jan. '46)

Frankhouser, Elmer V., Helene Apt., 3rd & Cooper Sts., Camden, N.J. (Oct. '44) *P*

Gannon, Timothy J., Asst. San. Engr., State Dept. of Public Health, 2008½ Parker St., Berkeley, Calif. (July '49) *MP*

Georgia, Ellis G., 29A Fremont Ave., Presidio Monterey, Calif. (Jan. '49)

Goode, Norman John, 10 Elmwood Rd., Baltimore 10, Md. (Jan. '47) *PR*

Hanlon, T. W., Jr., U.S. Pipe & Foundry Co., 1204 Praetorian Bldg., Dallas 1, Tex. (Oct. '39)

Hedgepeth, L. L., 23 Chestnut St., Bound Brook, N.J. (Aug. '29) *Fuller Award '44. PR*

Hess, John S., 432 Bay Ave., Clearwater, Fla. (Oct. '42)

Hoad, William Christian, 2114 Devonshire Rd., Ann Arbor, Mich. (June '13) *P*

Howell, Eugene M., 3916 Edison St., San Mateo, Calif. (Jan. '37) *MP*

John, Robert L., 607—9th Ave., Patterson Heights, Beaver Falls, Pa. (July '43) *P*

Jones, James R., U.S. Geological Survey, 429 Federal Bldg., Boise, Idaho (Apr. '49)

Kolkowitz, Hyman, 97-12—150th St., Jamaica, N.Y. (Oct. '48)

Leeson, Harold W., Sales Engr., Builders Pacific, Inc., 9358 Culver Blvd., Culver City, Calif. (July '46)

Lombana, Isaac, Apdo. de Correos No. 2.888, Caracas, Venezuela (Apr. '46)

Macomber, Ronald Gibbs, U.S. Public Health Service, 110 Chester Ave., Cleveland, Ohio (Jan. '48)

Mapes, Joe B., Resident Engr., Freese & Nichols, 407 Danciger Bldg., Fort Worth 2, Tex. (Oct. '47)

Merryman, Harold W., Asst. San. Engr., State Board of Health, 3rd & Frazer Sts., Pendleton, Ore. (Apr. '36) *MP*

Montgomery, James M., Cons. Engr., 15 N. Oakland Ave., Pasadena 1, Calif. (June '27) *P*

Peart, Robert F., City Mgr., City Hall, Garden City, Kan. (Apr. '49)

Peavy, Elton E., Southwestern Dist. Mgr., Dresser Mfg. Div., 1202 Kessler Pkwy., Dallas, Tex. (Oct. '48)

Plotkin, Sheldon N., Chem. Engr., Water Chemists, Inc., 1700 S. Main St., Los Angeles 15, Calif. (Oct. '47) *P*

Redmond, John, Jr., Capt., Box 72, University Station, Minneapolis 14, Minn. (Oct. '46)

Reinhardt, Arthur W., B. Street Pier, Room 7, San Diego, Calif. (Jan. '43) *P*

Roetman, Edmond T., Public Health Engr., U.S. Public Health Service, 5454 Vanderbilt, Dallas, Tex. (Feb. '34) *PR*

Ross, Herman M., Dist. Mgr., Graver Water Conditioning Co., 1101 Hippodrome Bldg., Cleveland, Ohio (Jan. '43) *P*

Roulston, Emerson, Box 123, Dunedin, Fla. (Oct. '48)

Sanborn, James F., Waquoit, Mass. (Aug. '21)

Stewart, Morgan E., 1848 Bidwell Way, Sacramento 18, Calif. (Jan. '44) *P*

Stone, Ralph, via American Embassy, Bogota, Colombia, c/o Dept. of State Mail Room, Washington 25, D.C. (Oct. '44) *P*

Stratton, Robert D., 45 Overlook Ave., Waterbury 12, Conn. (July '45)

Suryaprakasam, M. V., c/o C. D. Williams, Dept. of Civ. Eng., Univ. of Florida, Gainesville, Fla. (July '49)

Trostle, N. E., Dist. Mgr., Brown County Water Improvement Dist. No. 1, Brownwood, Tex. (Oct. '42) *M*

Tufts, William, Box 100, Sudbury, Mass. (July '47) *M*

Warren Foundry & Pipe Corp., John F. Benjamin, Sales Mgr., 55 Liberty St., New York, N.Y. (Assoc. M. Mar. '11)

Warrick, Louis F., San. Engr., U.S. Public Health Service, Div. of Water Pollution Control, Federal Security Bldg., Washington 25, D.C. (Apr. '20) *Fuller Award '40. PR*

White, Albert, Dist. Mgr., Pittsburgh Pipe Cleaner Co., 1712 N. 26th St., Birmingham 4, Ala. (July '49)

Winder, Norman G., 5210 Bradford Drive, Dallas 9, Tex. (Oct. '39)

Wirz, Herman, Jr., Field Supt., Dept. of Water & Power, 5506 Templeton St., Los Angeles 32, Calif. (Oct. '43) *M*

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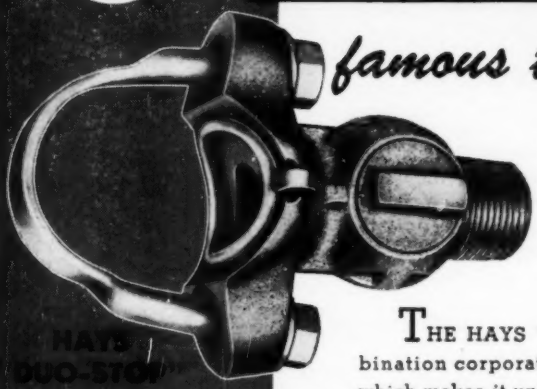

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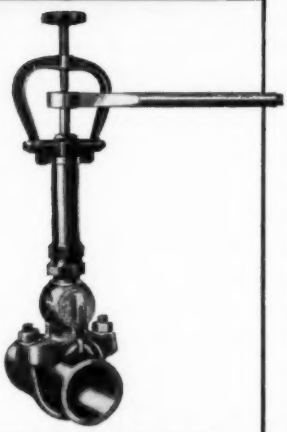

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Condensation

Key: In the reference to the publication in which the abstracted article appears, **39:473 (May '47)** indicates volume 39, page 473, issue dated May 1947. If the publication is paged by the issue, **39:5:1 (May '47)** indicates volume 39, number 5, page 1, issue dated May 1947. Abbreviations following an abstract indicate that it was taken, by permission, from one of the following periodicals: *B.H.—Bulletin of Hygiene (Great Britain)*; *C. A.—Chemical Abstracts; I. M.—Institute of Metals (Great Britain)*; *P.H.E.A.—Public Health Engineering Abstracts; S.W.J.—Sewage Works Journal; W.P.R.—Water Pollution Research (Great Britain)*.

FILTRATION

Cleaning of Filter Sands. THOMAS D. KEY. Wtr. & Wtr. Eng. (Gt. Br.), **52**:25 (Jan. '49). Problem of detg. direction and velocities of stream lines (in filter backwashing) as they pass upwards from bottom of filter to trough sills appears too complex to be worked out mathematically. Observable movements on surface of overlying water while backwashing indicate: [1] water surface between troughs always seen as dead water; [2] visible drawoff toward sill of trough limited to within 8" of outside edge of trough. Movements also fit following deductions: [1] silt deposited on filter moved horizontally toward troughs during backwashing; [2] somewhere close to troughs' edges there are stream lines having greater vertical velocities than 12 fpm. If these stream lines did not exist, filter sand of 0.6-mm. diam. could not be lifted out of filter. To substantiate assumptions, small replica of main filters built. Observations show that: [1] Air scour effectively broke up top surface of sand but produced no movement inside layer. [2] Time required to disrupt top surface was few seconds. [3] Definite contraction of sand layer resulted from incoming air expelling water lying in layer. [4] Air bubbles formed and remained permanent and almost stationary feature in supporting gravel. [5] Silt lying on top surface never completely removed by backwashing but accumulated and penetrated layer during subsequent backwashings and ultimately fouled it so that sand grains adhered to each other. [6] Backwashing flows employed never disrupted layer or threw sand into suspension in water. They lifted finely divided silt particles but not denser coagulated silt particles. [7] Gravel supporting filter disrupted and thrown up into sand when reverse flow passed into filter drained of water. [8] Filter contracted when put into commission after backwashing. Rate and duration of contraction could not be measured, but careful observations showed shrinkage taking

(Continued on page 42)

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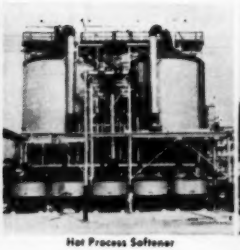
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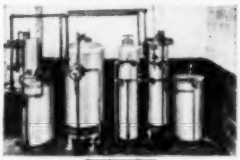
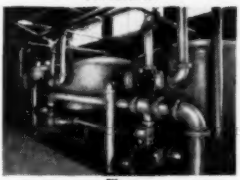

Demineralizer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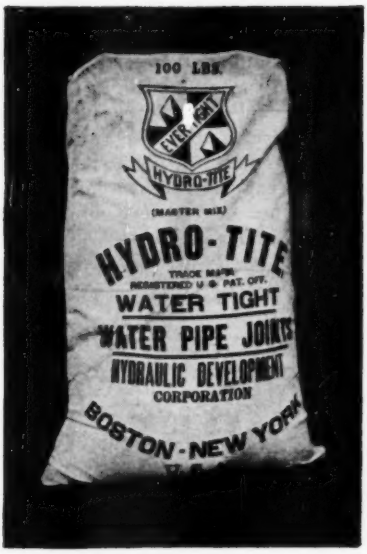
(*Continued from page 40*)

place 10 min. after filter had begun operating. Fall in surface level amounted, in all, to about ½". Concluded that benefits derived from air scouring have been largely overraced and sometimes do more harm than good; when air scour employed, bubbles of air collect and remain in supporting gravel, providing favorable conditions for growth of minute worms; normal rate of vertical rise not in itself sufficient to lift flocculated silt off filter, but vertical induced currents, set up by adhering nappe weir discharge near wash water troughs, can do so. At commencement of backwash, sand, when unclean, tends to rise off supporting gravel bed; ineffectively cleaned filter sands acquire adhesiveness and tendency to bind when subjected to contraction pressure following air scour, so that when backwash pressure applied undulations in bed set up, causing surface cracks that develop into permanent feature. Filter put to rewash after backwashing, contracts slightly during next 10–20 min.; and when filter emptied of water content, almost universal practice is to refill by allowing backwash water to enter from bottom. This practice can disrupt and throw supporting gravel into sand. Apparent cause is rapid increase in veloc. of backwash water when passing from gravel into sand at time when interstices full of air. It appeared that by turning conventional wash water trough upside down, deposited silt could be drawn across filter more effectively than by weir discharge. Such trough need consist only of two side plates extending across filter with outlet at one end, so that, during backwashing, level of water between plates must necessarily be lowered below that outside and underflow induced across filter which would draw deposited silt under and into trough area. Trough of this kind would also provide localized withdrawal from level close to top of fil-

(*Continued on page 44*)

HYDRO-TITE



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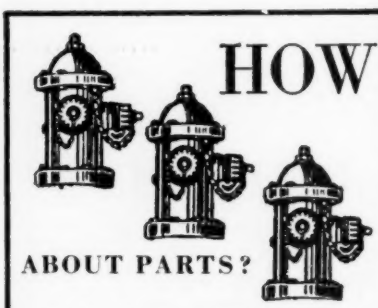
(*Continued from page 42*)

ter when in expanded condition and should more easily remove impurities. Small exptl. filter built incorporating this wash trough. Expts. proved that unflocculated silt could be removed, either from surface or when held in bed, with new design of trough. Universally accepted means of decanting backwash water by weir discharge into **U**-shaped trough not most efficient way; better results can be obtained by turning trough upside down and obtaining localized withdrawal from level close to top of filter in expanded condition during backwashing. **Discussion.** R. W. AITKEN. *Ibid.*, **52**:130 (Mar. '49). Slow sand filters not fundamentally same as rapid sand type. They will not work when sand is clean, because removal of impurities carried out by "schmutzdecke" formed on top of sand. Rapid sand filter relies on deposition of particles in suspension in water on surface of sand grains within filter. Number of rapid gravity filter plants have no wash water trough. In majority of these, wash water discharges over weir at one end of filter, lip of weir being 4–6″ above top of sand. Contraction of sand layer when air scour applied similar to contraction obtained when any granular material shaken. Rising of sand as "piston" when water turned on does not occur in large filters. Relative vertical movement of sand grains due to fact that sides of filter in author's expts. not perfectly vertical. His suggestion that air scour harmful not backed by supporting data. He draws horrid picture of minute worms developing in air bubbles. Method described by author to keep veloc. of water above sand as

(*Continued on page 46*)



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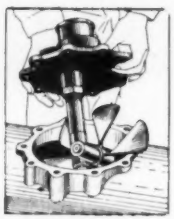

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(*Continued from page 44*)

high as possible not believed to be necessarily best. Before fair comparison can be made with existing methods, more information necessary; in particular: [1] max. loss of head before filters washed, [2] percentage of wash water used and [3] avg. quant. of suspended matter in water going to filter. When suspended matter allowed to collect on surface only, so that filter used as strainer, runs will be short in relation to quant. of impurities retained. Duty of air scour or surface wash or mechanical rakes is to break up upper portion of layer so that all particles contg. dirt have lower hydraulic settling value than sand. In America high-veloc.-wash filters only partially successful in overcoming mudball problem. Practice of using high-veloc. jets of water directed downwards on surface of sand, in conjunction with normal upwash, has become popular. Efficiently designed air scour system enables filter to deal with conditions in which particles enter filter and are deposited on sand grains. Full use made of capac. of filter to retain dirt while maintaining reasonably long runs and min. waste of wash water. **Rebuttal.** THOMAS D. KEY. *Ibid.*, **52**:291 (June '49). Incontestable that both slow sand and rapid sand filters act as strainers for removal of suspended matter, including bacteria, and this accomplished, in part, by absorptive power of surface film which surrounds each sand grain. Therefore, Aitken's statement that slow sand filters remove impurities by slimy film on surface, and rapid sand filters by slimy film formed inside bed, is only one of degree and not fundamental design principle of filters. True that infestations of worms may appear close to and around underdrain, often for no explainable reason. As elimination difficult, anything favorable to their growth —for instance, air bubbles when air scour used—should be avoided. Flocculated suspended matter not kept in

(*Continued on page 48*)

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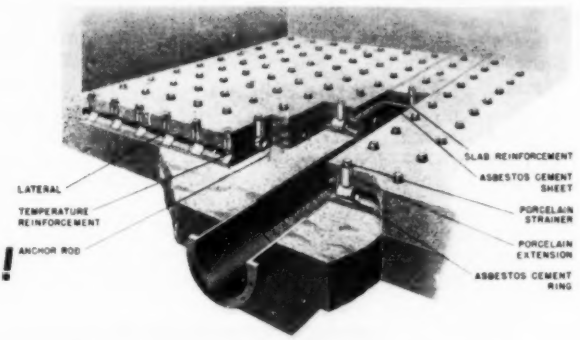

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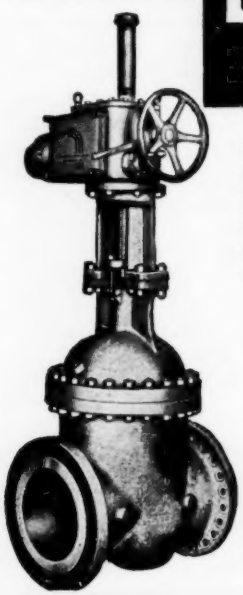
(*Continued from page 46*)

suspension over filter and could not leave filter tank until moved horizontally across bed toward troughs during backwashing. Filters backwashed every 24 hr., regardless of head loss. During summer percentage of wash water 2.04, while in winter rises to 3%. Obviously lower percentage would be obtained if filters were run to max. head loss of 6'. However, advantage of scheduling backwashings when lab. staff present has been found to outweigh saving in wash water.—*H. E. Babbitt.*

Slow Sand Filters. The "Sivade" Method of Cleaning. ANON. Wtr. & Wtr. Eng. (Gt. Br.) **52**:351 (July '49). To clean top dirty layer of sand by backwashing, wash water rate on order of 820 gph./sq.ft. (Imp.) required. Originality of Sivade method lies in limiting area subject to back flushing to about 32 sq.ft. by movable enclosure of filtering surface which requires rate of flow easily obtainable. Apparatus consists essentially of clean-water injection grill mounted on dirty-water suction box. Injection grill composed of horizontal tube perforated by numerous small holes and fed by vertical tubes through which clean water supplied by injection pump. Suction box, which extends full width of filter, with small clearance at each end, has shaft at center through which dirty water drawn by extraction pump. Grill and box can be raised and lowered. Equipment mounted on traveling bridge, which moves on rails above filter bed. Selector, as apparatus is called, driven to one end of filter; injection and extraction pumps started; suction box lowered until

(*Continued on page 50*)



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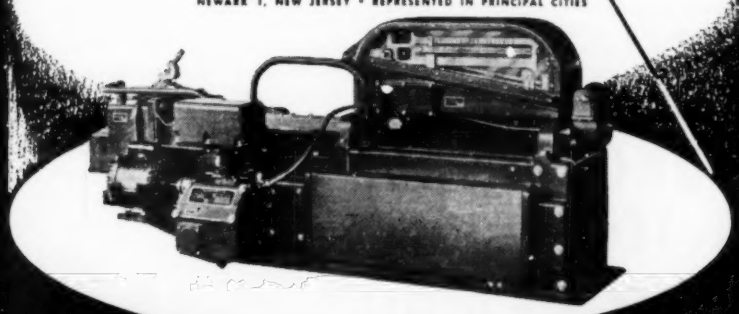

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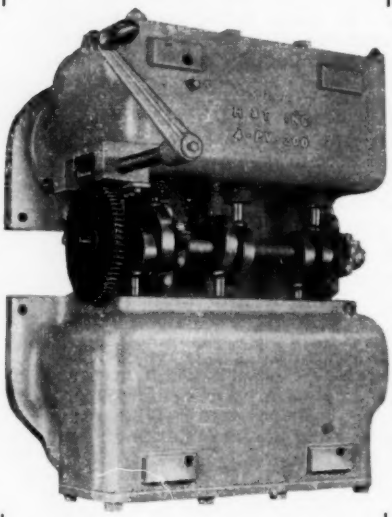

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(*Continued from page 48*)

sides penetrate surface of sand; and grill lowered. Injected water, which puts sand in suspension, moves upward inside vertical slice of sand bounded by edges of suction box. Speed of water current entrains only mud. Sand thoroughly cleaned throughout its thickness. Wash water consumption less than 1% of water filtered. Power consumption less than 7 whr. per 1000 gal. (Imp.) filtered. One man in 1½ hr. can clean two prefilters with total surface area of 4300 sq.ft.—*H. E. Babbitt.*

How to Utilize Natural Sands for Rapid Filtration. P. FRISON. L'Eau (Fr.) **36**:7, 25 (Jan., Feb. '49). Choice of natural sands for filtration not difficult, but requires study and practical application. To determine physical properties of sand, rub some fine sand in hand, observe light crackling; put small amount of sand in glass of water. If sand pure, water remains limpid; when some sand placed on white cloth, no foreign matter should adhere. Dry sand at 110°C. and keep sample in 20% HCl for 24 hr., then dry again. Loss should be less than 5%. Determine effective size and uniformity coefficient.—*W. Rudolfs.*

TASTE AND ODOR CONTROL

A Tasteless Residual at the Tap. K. S. MACLEOD. Wtr. & Sew. (Can.) **86**:8:22 (Aug. '48). ClO_2 successfully employed over 2 yr. in Scarborough Township, Ont., to remove tastes and odors which occur with varying intensity throughout yr. and reach peak in spring and fall. $NaClO_2$ introduced into discharge from chlorinator in ratio 1:1 by wt. to Cl, varies from 3 to 4.5 lb./mil.gal., depending on severity of taste and odor. Tests using Haller and Listek's amperometric Na arsenite titration method showed that ClO_2 residuals persist

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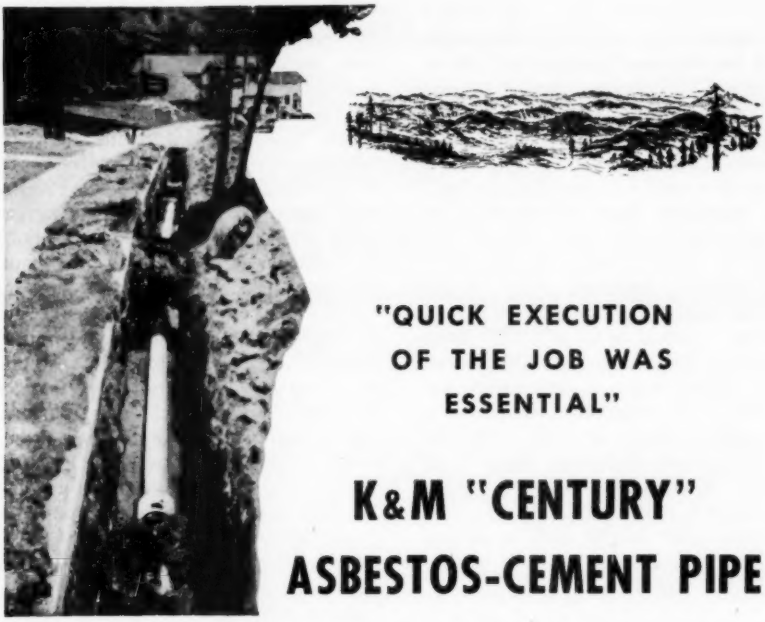

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(*Continued from page 50*)

throughout distr. system in amts. sufficient for effective bacterial kill, whereas free Cl disappears almost at once and only negligible amts. of less effective chloramines remain. No consistent relationship between *o*-tolidine residuals (total Cl) and bacterial kill, but relatively exact relationship between bacterial kill and residual indicated by *o*-tolidine-arsenite test, which differentiates between free Cl and chloramines. This relationship holds whether residual is Cl or ClO_2. Demonstrated elsewhere that ClO_2 equals Cl in effectiveness as bactericide and, moreover, is relatively insensitive to changes in temp. and pH. Amperometric titration method, which is described, distinguishes between free Cl, chloramine, ClO_2 and chlorite, and complete anal. can be made in 20 min. Results reproducible to 0.01 ppm.—*R. E. Thompson.*

Waste Waters From Coal Processing Industries and Water Supply. F. MEINCK & A. SPALTENSTEIN. Gesundh.-Ing. (Ger.) **68**:7 ('47). Tastes may appear on chlorination of water contg. phenol in concn. below that detectable by chem. tests. Complete prohibition of discharge of waste water contg. phenols to surface waters used for supply not economically possible and most complete treatment at present possible for such waste waters (by recovery of phenol, followed by biol. treatment and treatment with adsorptive ash) will not reduce phenol to less than 3–10 ppm. Limiting concn. above which taste may be caused on chlorination known to be about 0.002 ppm. for phenol and somewhat lower for cresols, but no agreement on limit for higher phenols. Nonvolatile higher phenols must not, however, be disregarded; phenol recovery processes involving evapn. greatly increase ratio of these higher phenols to volatile phenols. Expts. described in which formation of taste in presence of free chlorine by various phenols investigated. In one series of tests, substances used included phenols, cresols, naphthols, guaiacol, xylenols, resorcinol, pyrocatechol, hydroquinone and pyrogallol; no chlorophenol taste detected with *p*-amidophenol, pyrocatechol, resorcinol or pyrogallol, even at concns. of 5000 ppm. Expts. then carried out with volatile phenols in Berlin tap water at pH values of 4.0 and 7.4 and temps. between 12° and 15°C. With almost all volatile phenols tested, "threshold concn." (lowest concn. at which chlorophenol taste could be detected) much lower at pH 4.0 than at pH 7.4 and much lower than that commonly found in streams to which waste waters contg. such phenols discharged. Detn. of concn. of phenol in stream not re-

(*Continued on page 54*)

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(*Continued from page 52*)

liable method of judging probability of appearance of taste on chlorination; necessary to det. concn. in waste water before discharge and diln. afforded by receiving stream. As, however, there are great differences between different phenols in lowest concn. causing taste, and as waste waters from different processes contain different mixts. of phenols, expts. made with samples of waste waters from various processes of treatment of hard and soft coals to find threshold concn. Values obtained varied considerably but appeared to depend upon proportion of phenol and cresols in mixt. of phenols. Another possibility examd. was whether compn. of mixt. of phenols in waste water altered, by removal of phenol by tricresyl phosphate process, Phenosolvan process or Koppers process, so as to affect taste formation. No such effect found after treatment by tricresyl phosphate process but threshold concn. increased by treatment by other two processes. Diln. required may be to some extent affected by reaction of water (generally weakly alk.) and by self-purif. in stream. Tests also made of effect, on production of taste by volatile phenols, of ammonia-chlorine treatment and treatment with chloramine. Results show that in neutral or alk. water threshold value considerably increased by ammonia-chlorine treatment and very much more increased by treatment with chloramine. —*W.P.R.*

OTHER ARTICLES NOTED

Effects of Reservoir Operation on Stream Water Quality. R. L. Woodward & M. LeBosquet Jr. U.S. Pub. Health Repts., **64**:39:1223 (Sept. 30. '49).

Corrosion Problems in Water Wells. T. E. Larson. Water Well Jour., **3**:5:19 (Sept.-Oct. 1949).

Reclaiming Water From Sewage Pub. Wks., **80**:10:56 (Oct. '49).

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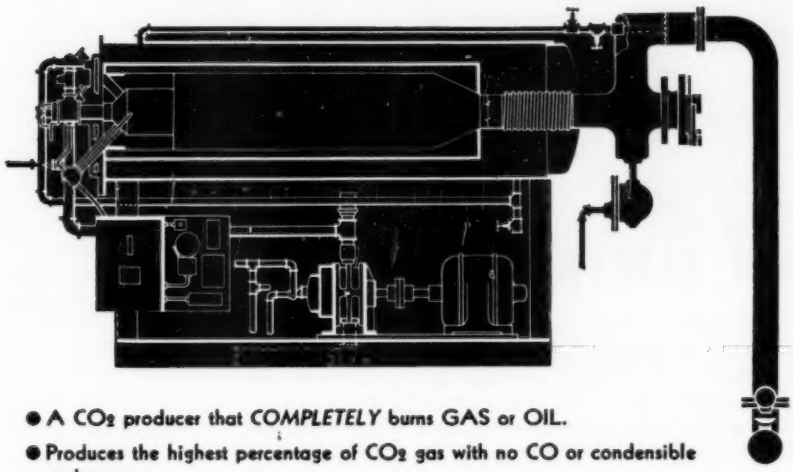

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(*Continued on page 58*)

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(Continued from page 54)

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"Modern Metal Finishing," publication of which has been suspended by the Du Pont Co. since June 1941, has reappeared and will again contain articles about technical developments in the treatment of metals—descaling, cleaning, heat treating and electroplating.

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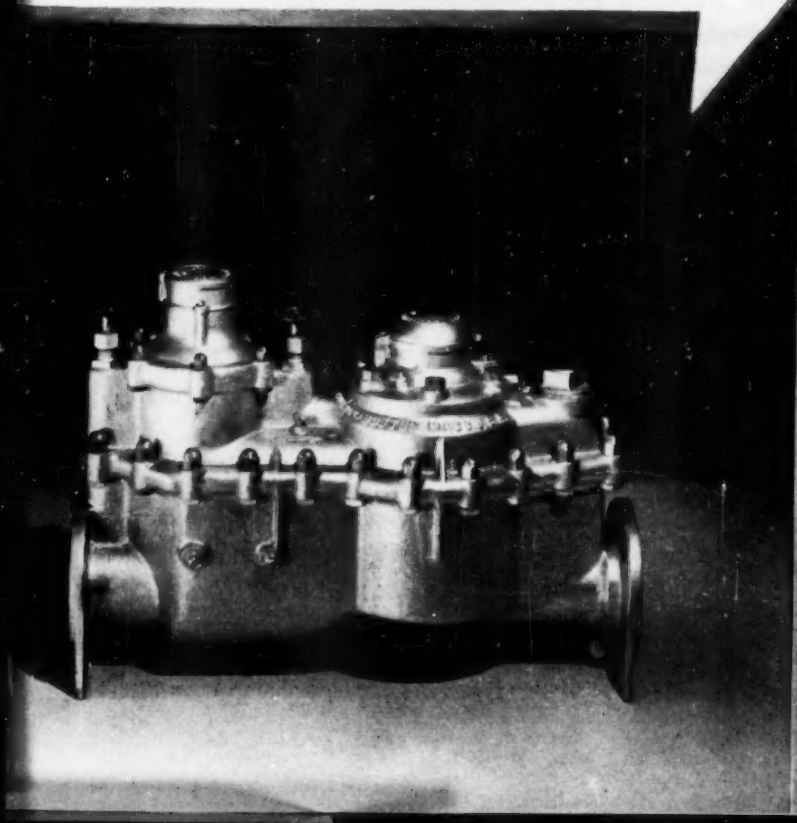

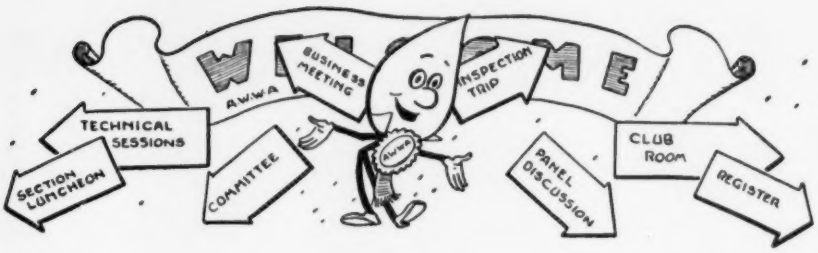

Section Meeting Reports

West Virginia Section: The eleventh annual meeting of the West Virginia Section was held at Oglebay Park, Wheeling, on September 22–23. The water works meeting immediately followed the third annual meeting of the West Virginia Sewage and Industrial Wastes Assn. with a joint banquet held for both groups the evening of September 22nd. A total of 123 registered for the water works meeting, which was somewhat below the average for the past several years.

The meeting place was an unusual one for the section. Oglebay Park is a magnificent 800-acre enterprise maintained by the city of Wheeling. The park operates a series of well appointed cabins, in which the majority chose to stay, the less hardy repairing to the Wheeling hotels. Most everyone enjoyed the change, and all were appreciative of the efforts of the local arrangement committee. The technical sessions were held in the Pine Room, a well equipped assembly hall.

The first technical session opened on the afternoon of September 22nd with Chairman J. A. Sample presiding. The first scheduled paper was "Chlorine Dioxide" presented by John F. Synan, Mathieson Alkali Co., who gave an account of the development and application of chlorine dioxide in water treatment. This provoked considerable discussion by A. R. Todd of Wheeling, P. D. Simmons of Weirton, Lawson Haynes of Charleston, Everett Chandler of Williamson, and Dr. W. W. Hodge of the Mellon Institute, Pittsburgh, Pa. Todd, Simmons and Chandler reported success in controlling phenolic tastes, whereas Haynes reported a failure in preventing tastes caused by chemical plant wastes in the Kanawha River.

The national headquarters of the Association was ably represented by Vice-President W. Victor Weir, who spoke on the subject "The A.W.W.A. Helps the Water Works Industry." The section was also honored to have Past-President Wendall LaDue from nearby Akron, Ohio, in attendance at the meeting.

A softball game between the section and the sewage and industrial wastes association had been ambitiously scheduled for September 22nd, but

(*Continued on page 62*)

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(*Continued from page 60*)

to the relief of all concerned, some inspired member decided the playing field was too wet and the contest was called off.

A pleasant banquet was held in the Pine Room Thursday evening. Toastmaster Ray Corll of the Weirton Steel Co. introduced the dignitaries and guests, and served as announcer for the entertainment which followed. The section was entertained with a concert by the nationally famous Weirton Steel Male Chorus, directed by T. Herbert Davies.

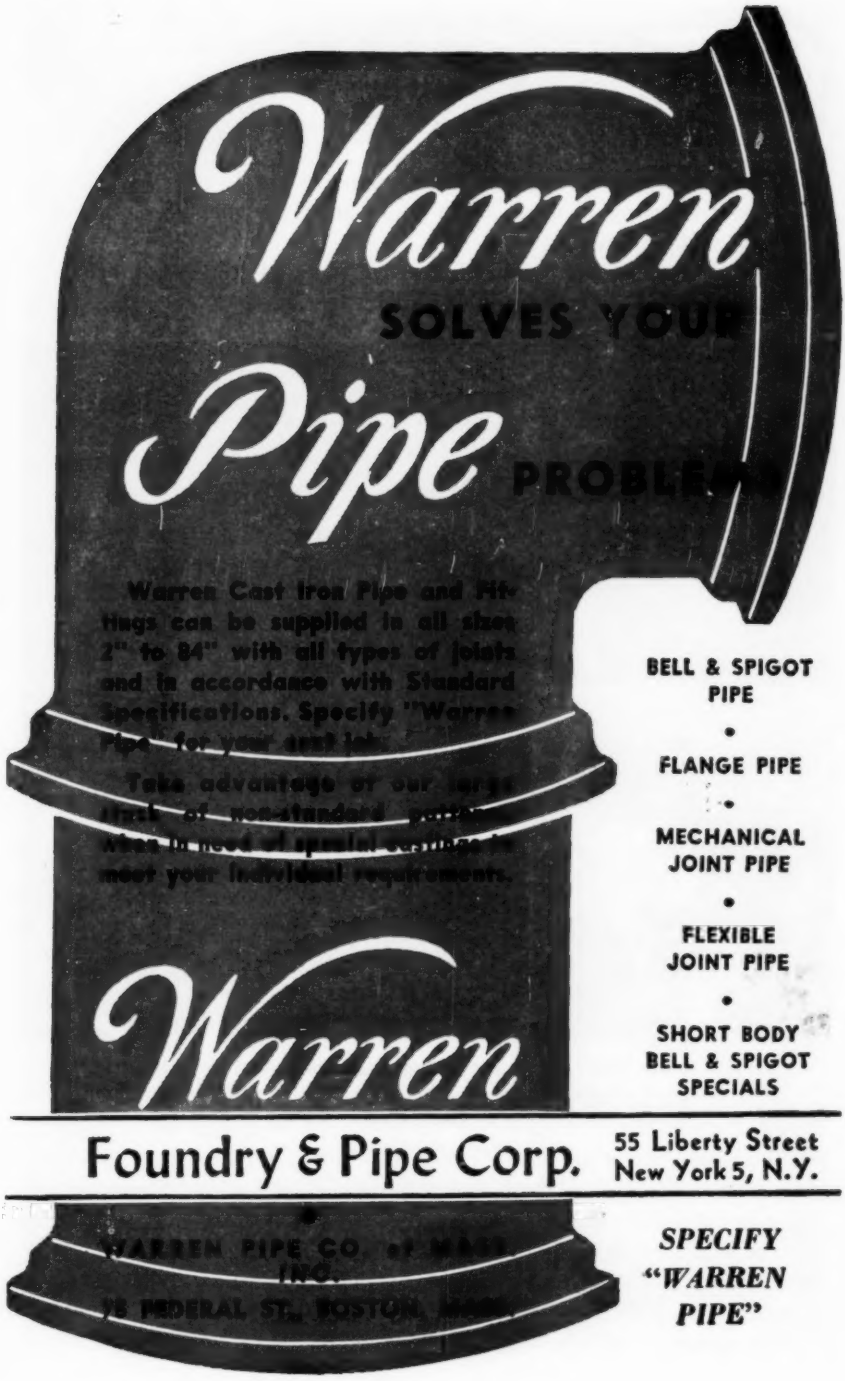
The September 23rd session opened with Chairman Sample presiding. Milo Gray, Safety Director, Weirton Steel Co. opened with an informative talk on "Safety Problems." Attention was called to the common disregard of ordinary safety precautions around water works. Lengthy discussion from the floor dealt primarily with the handling of chlorine.

The Public Service Commission of West Virginia, working with a representative committee of water works officials in the state, revised and issued in 1948 "Water Rules and Regulations of the West Virginia Public Service Commission." Earle H. Morris, chief engineer of the commission, presented several of the important rules for discussion, and pointed out that the commission intends to enforce the rule requiring the maintenance of accurate distribution system maps. Most interest was expressed in the rule which fixes the procedure for extending water service.

A "question box" was established at the registration desk at the start of the meeting and more questions were submitted than could be answered in the 45 minutes allotted to the subject. Chairman Sample read the questions and called for answers and discussion from the floor. Two questions which provoked a lot of discussion were "Can filter sand be cleaned in place by an inhibited acid, such as is used in acidizing oil wells?" and "What can be done to increase the pay of water plant operators?" It was the general consensus that care should be used in the acidizing procedure, and that only an organization with acidizing experience and equipment should be allowed to work in a plant. Salary increases was judged to be a matter which could be worked out only at the local level, with each situation presenting a different problem.

The concluding item on the program was a panel discussion with H. K. Gidley, Div. of Sanitary Engineering, State Health Dept.; H. W. Speiden, Head, Civil Engineering Dept., West Virginia University; and Lawson Haynes, superintendent of filtration, Charleston; participating. The subject for discussion was "Licensing and Training of Water Plant Operators in West Virginia." The panel discussed the history of licensing in West Virginia, and the practical application and administration of the licensing law. As a result of the discussion, a committee was appointed to study the feasibility of selecting three or four operating plants as training schools for operators, with a fee to be paid to the plants participating in the program.

(*Continued on page 64*)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(*Continued from page 62*)

It was also brought out that the State Health Dept. has under consideration a correspondence course for water plant operators.

H. K. GIDLEY
Acting Secretary

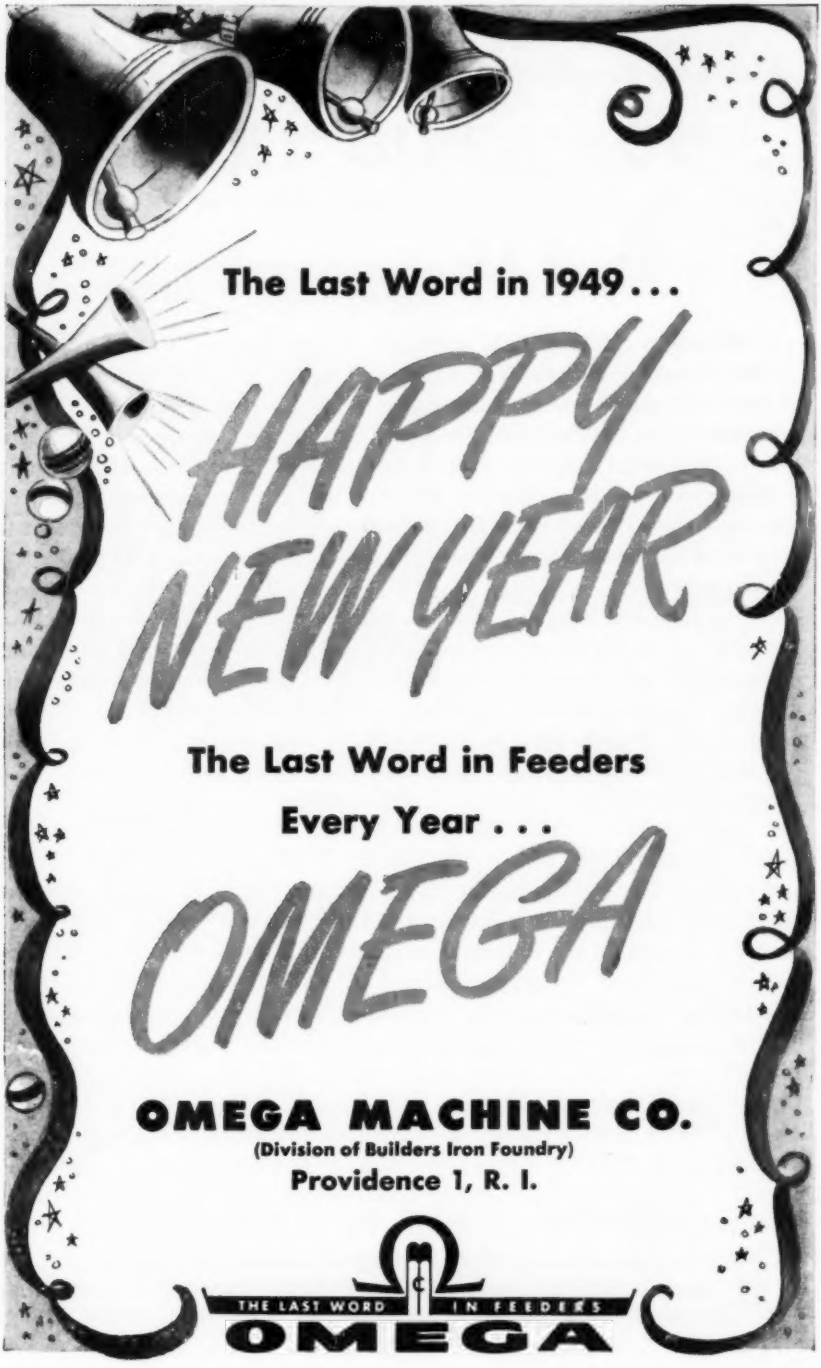
Missouri Section: The Missouri Section met jointly with the Missouri Water and Sewerage Conference in Joplin on September 25, 26 and 27. The total registration was 199.

The program, which was well received, centered around two principal debates: Elevated water storage vs. Ground elevation water storage; and

Joplin meet offers food for thought as men—and a lady—from Missouri get shown (above). Banquet meat also proved nourishing (below).

Shall a public water supply be metered or not metered? The discussion was not the usual panel type, but a regular debate with affirmative and negative sides and rebuttals. One afternoon was devoted to discussion of ground waters, including "Artificial Recharge of Ground Water," "Uniformity of Ground Absorption and Storage of Surface Water Underground," and "Electro-logging of Water Wells."

(*Continued on page 66*)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(*Continued from page 64*)

President A. P. Black and Vice-President W. Victor Weir were present during the entire meeting. The meeting concluded with a banquet, at which Dr. Black spoke on A.W.W.A. affairs.

Guests of the meeting included U.S. Public Health Service engineers of the Div. of Water Pollution Control: Glenn Hopkins, Kansas City, Mo.; Richard Poston, Dallas, Tex.; S. C. Martin, Chicago; and Carl Warkentine, Little Rock, Ark.

W. A. KRAMER
Secretary-Treasurer

Michigan Section: The eleventh annual meeting of the Michigan Section was held at Park Place Hotel in Traverse City on September 28th to 30th. Registered attendance totaled 262, including 51 women. It was only three years ago, in 1946, that a previous meeting was held in Traverse City. The early return is evidence of the excellent hotel facilities, the hospitality of the people and the city, and of the enviable scenic beauty of the area. The present meeting was such a success in every matter that it would not be too surprising to see the section return once again in the not too distant future.

The technical program included such subject material as a review of the highlights in the water works industry in Michigan during the past year; discussion of revenue bonds and their application; recent developments in chlorine dioxide chemistry and control, and an informative talk on liquid alum. John Hepler, director of the Div. of Engineering, Michigan Dept. of Health, discussed "What the State Health Department Expects of a Licensed Water Plant Operator." He explained that each licensed operator was a public health worker and as such was expected to help safeguard the health of the people at all times. A discussion by Douglas Feben and Michael Taras of the Spring Wells Filtration Plant in Detroit centered on "Chlorine Demand Constants of the Detroit Water Supply" and "Preliminary Studies on the Relationship Between Chlorine Demand Constants and Specific Chemical Compounds."

George Francis, consulting engineer of Saginaw, reviewed the solution of Ontonogan's water problem with an infiltration gallery located along Lake Superior. Earl Norman, Kalamazoo; Albert A. Campbell, Wayne County; and Charles W. Darling, Grand Rapids; discussed "Methods for Making Water Service Extensions Beyond Corporate Limits." On Thursday afternoon, William Keck, consultant in ground water problems, discussed "Locating Ground Water by Electrical Resistivity Surveys." From the data presented it was quite apparent that these newer methods for locating ground water will be used more frequently as water demands continue to increase. In this same vein, Norman Billings, Geological Survey Div., Dept. of Conservation, discussed "Experiences in Solving Ground Water

(*Continued on page 68*)

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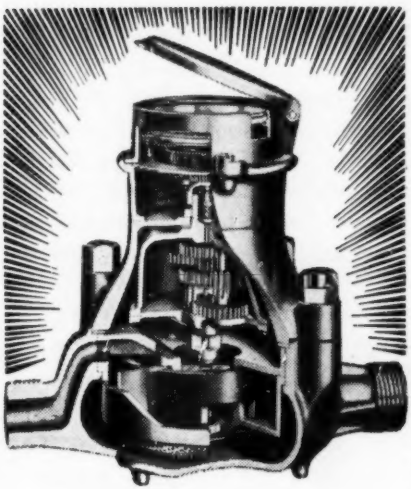

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4. LOW UPKEEP. Split case design, with spuds in the base, permits removal of working parts for quick cleaning or inspection without disturbing main line connections. Easy to repair.

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CALMET WATER METERS

MADE BY WELL MACHINERY & SUPPLY CO., INC.—FORT WORTH, TEXAS

(*Continued from page 66*)

Problems." It was apparent from his discussion that any town desiring to develop a ground water supply should obtain as much assistance as possible prior to making a final commitment on the type and location of a supply. A discussion of five of the more important ground water pollution problems which had occurred during the past several years in Michigan was held with the hope that publicizing the hazards may result in improved waste disposal methods.

The technical sessions ended with the Friday morning meeting at which H. E. Smith, superintendent of water at Adrian, outlined the basis for choice between monthly and quarterly billing, and Harry E. Jordan gave a serious discussion on the "Value of Standards to the Water Works Industry." A round-table closed the technical sessions with reviews of two subjects: Tentative minimum standards of design for water distribution systems, and Review of proposed regulations for the control of ground water pollution. These subjects produced active participation and resulted in the appointment of committees to study the problems and report back at a later date.

Again the section was indebted to the manufacturers' representatives for providing clubroom entertainment and refreshments. This type of

(*Continued on page 70*)

ORTHO-TOLIDINE-

ARSENITE TEST

The ortho-tolidine-arsenite test can be performed conveniently and accurately with Hellige Color Plates and Color Discs for chlorine determinations. Directions will be furnished without charge. Please specify the article number of the color plate or disc, or the comparator model.

Ortho-Tolidine Solution
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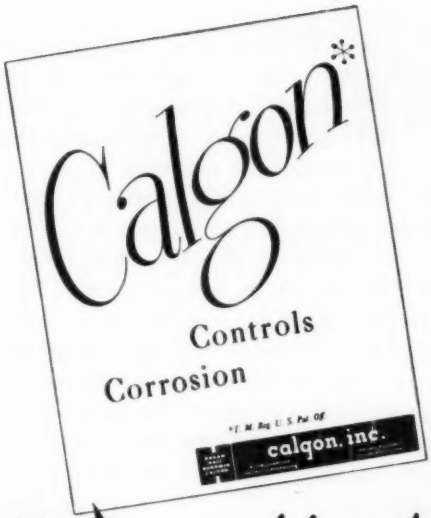

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In the fall of 1941, the Lynchburg water department began a series of tests of Calgon, and as a result of these tests, started Threshold Treatment with 1 ppm of Calgon shortly before the beginning of 1942. At the same time, use of soda ash in the water system was discontinued.

After five years successful use of Calgon, the Department decided to make a thorough check of its effectiveness. Calgon treatment was discontinued and the use of soda ash resumed.

Within a few months, red water reappeared. Once more Calgon feeding was started, and once more corrosion difficulties ceased.

Lynchburg is only one of many hundred communities of all sizes where Threshold Treatment with Calgon is used to prevent scale, control corrosion, eliminate "red water" or stabilize water following lime softening.

Calgon representatives will be glad to discuss the use of Threshold Treatment in your plant.

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(*Continued from page 68*)

entertainment has proven itself to be desirable and enjoyable and continues to have strong support from the Water and Sewage Works Manufacturers' Assn.

The annual banquet was a grand success and featured such items as the presentation of Edward Dunbar Rich Service Awards to 94 persons who had completed 25 or more years of meritorious and faithful service in providing and maintaining a safe and adequate public water supply in Michigan. Col. Rich was present to congratulate the awardees in person. The toastmaster at the banquet was Francis DuBois of Detroit who did a commendable job of keeping everyone happy and alert so as not to miss any of his well prepared witticisms. Dr. Albert E. Heustis, commissioner of the Michigan Dept. of Health, and Harry E. Jordan both gave short talks, and Dr. Don L. Gibb of the Dow Chemical Co. spoke on plastics.

The ladies had their own program which featured "An Evening at the Hoffmaster Art Studio," and a scenic tour of Grand Traverse-Leelanau Counties sponsored by the Traverse City Iron Works. The ladies were fortunate in having fine weather and the season of the year provided plenty of color to make the trip a tremendous success. The luncheon at Bourne's on Lake Michigan was enjoyed by 61 ladies.

R. J. FAUST
Secretary-Treasurer

Iowa Section: The annual meeting of the Iowa Section on October 6–7 was acclaimed by all those in attendance to be a grand success. The sessions were well attended, the discussions were interesting and informative, and the entertainment was superb. The total registration was 138, not including the 25 ladies. Of those registered, 57 were water works employees representing 28 cities, 50 were manufacturers' representatives, and the remaining 31 were professors, engineers and employees of the State Dept. of Health and the State Geological Survey.

The session opened with a discussion of water meter maintenance. Wilbur Bjork described how meters were repaired in the Des Moines Water Works meter shop and a lively discussion followed. Dale Maffitt, general manager of the Des Moines works, led a panel discussion on the subject of "Benefited Water Districts Outside the City Limits." This discussion disclosed such widely different practice that it ended with the passage of a resolution asking for the creation by A.W.W.A. of a special committee to conduct a nation-wide study of the subject and to recommend a uniform and accepted policy.

Dr. Ralph H. Heeren, Director of Preventable Diseases of the State Dept. of Health, in discussing how water supplies affect public health, said that an excess of 20 ppm. of nitrates in a water supply caused blue babies and an excess of 200 ppm. of sodium in water often was the cause

(*Continued on page 72*)

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of heart trouble. If fluorine is added to water, he recommended a residual of not more than 1.25 ppm. for Iowa.

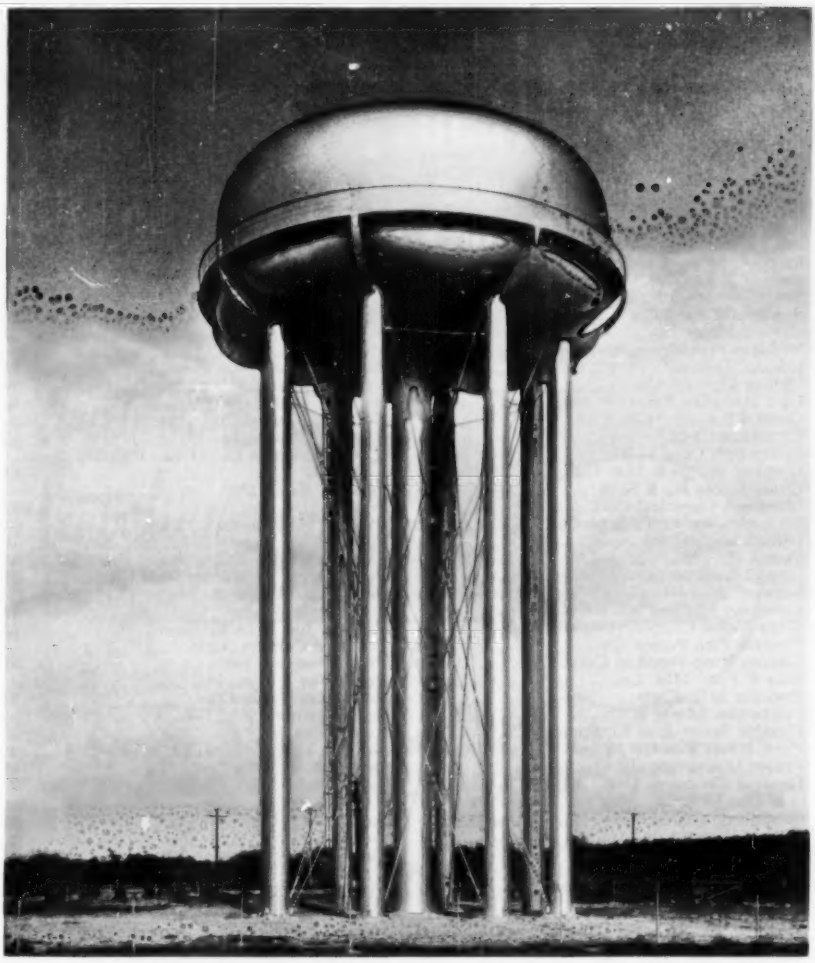
Harry J. Corcoran, engineer of the Iowa Inspection Bureau, discussed fire insurance rates. He stated that, although fire rates are based both on adequate water and fire departments, more stress is placed on the fire departments. He also stated that, although the differences in requirements for Class 5–6–7–8 ratings are relatively slight, very few cities are placed in the higher classifications.

Col. Jack J. Hinman, now a consulting engineer, showed a number of slides he had taken in Japan and told many of the interesting water works practices of the Japanese. He stated that a few of the larger cities in Japan had plants capable of producing good water, but that the great majority of the plants were quite poor. Most of the water supplies are obtained from mountain streams which can best be treated with slow sand filters.

President A. P. Black concluded the technical sessions with a survey of recent advances in water treatment. He outlined the history of the use of chlorine in such an interesting way that even the peddlers listened attentively and the water works men marvelled about his general knowledge of water works systems. He talked about water softening and fluoridation and in general endeared himself to the Iowa Section.

The smoker on October 6th, sponsored by the manufacturers' representatives, was outstanding. The food, served buffet style, was excellent and abundant, and everyone in attendance was well pleased. Mark Driftmier, superintendent at Burlington and chairman of local arrangements, can be congratulated on arranging the classical floor show consisting of a group of talented teen-age dancing girls. The dinner on the evening of October 7th was attended and thoroughly enjoyed by 115 persons. Dr. Black told stories in his Texas drawl which brought down the house and did much toward raising the morale of the section. Watch the Iowa Section go!

H. V. PEDERSEN
Secretary-Treasurer



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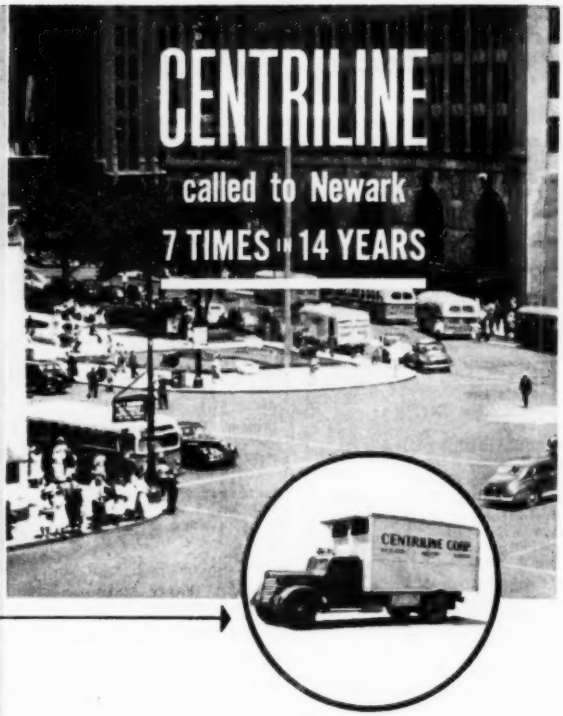

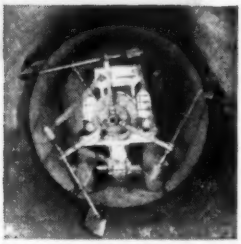

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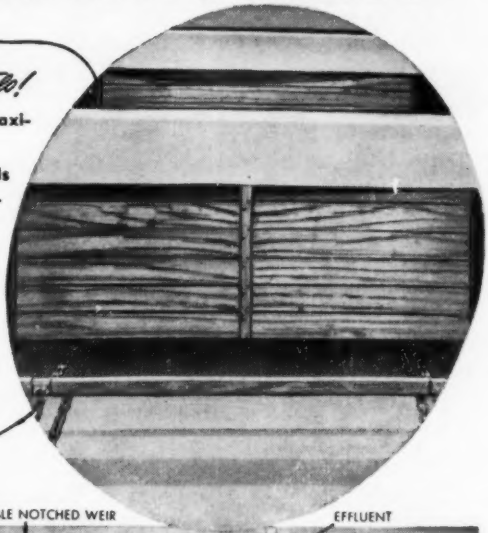
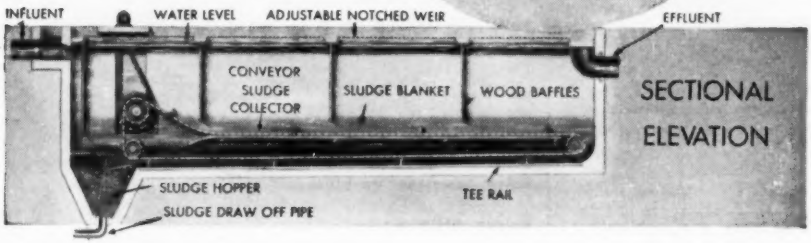
- Allows compact, economical grouping with other structures because of rectangular shape.





Rex Verti-Flo Clarifier delivers a highly clarified effluent with an extremely short detention period. This new, efficient unit consists of a series of adjustable weirs and baffles which divide a rectangular settling tank into a series of cells. Weirs are adjusted to regulate closely the flow distribution among the cells for maximum efficiency. Extremely long weir length is obtained with this unique principle. The combination of large weir length and low vertical velocities assures a clearer effluent . . . far greater capacity . . . minimum cost.

Rex Verti-Flo can be installed in existing tanks to increase capacity and improve performance. In new construction, use of this highly efficient unit can help reduce construction costs by holding required tank size to a minimum.

Rex Conveyor Sludge Collectors can be used with Verti-Flo to concentrate sludge at one end of the tank and to maintain a fluid sludge blanket where desired.

For all the facts, write Chain Belt Company, 1609 West Bruce Street, Milwaukee 4, Wis.

CHAIN BELT REX COMPANY SANITATION EQUIPMENT

Pumps, Turbine:
DeLaval Steam Turbine Co.
Fairbanks, Morse & Co.
Layne & Bowler, Inc.
Peerless Pump Div., Food Machinery Corp.
Worthington Pump & Mach. Corp.

Recorders, Gas Density CO_2, NH_3, SO_2, etc.:
Permutit Co.
Wallace & Tiernan Co., Inc.

Recording Instruments:
Builders-Providence, Inc.
Infilco, Inc.
R. W. Sparling
Wallace & Tiernan Co., Inc.

Reservoirs, Steel:
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Sand Expansion Gages:
(See Gages)

Sleeves:
(See Clamps)

Sleeves and Valves, Tapping:
James B. Clow & Sons
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.

Sludge Blanket Equipment:
Permutit Co.

Soda Ash:
Solvay Sales Div.

Sodium Hexametaphosphate:
Calgon, Inc.

Softeners:
Belco Industrial Equipment Div., Inc.
Dorr Co.
Hungerford & Terry, Inc.
Infilco, Inc.
Permutit Co.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.

Softening Chemicals and Compounds:
Calgon, Inc.
Infilco, Inc.
Permutit Co.

Standpipes, Steel:
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Steel Plate Construction:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Storage Tanks:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Strainers, Suction:
M. Greenberg's Sons
R. D. Wood Co.

Sulfur Dioxide, Liquid:
Virginia Smelting Co.

Surface Wash Equipment:
Permutit Co.
Stuart Corp.

Swimming Pool Sterilization:
Belco Industrial Equipment Div., Inc.
Everson Mfg. Corp.
Omega Machine Co. (Div., Builders Iron Fdry.)
Proportioneers, Inc.
Wallace & Tiernan Co., Inc.
Welsbach Corp., Ozone Processes Div.

Tanks, Steel:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Tapping Machines:
Hays Mfg. Co.
Mueller Co.
A. P. Smith Mfg. Co.

Taste and Odor Removal:
Industrial Chemical Sales Div.
Infilco, Inc.
Proportioneers, Inc.
Walker Process Equipment, Inc.
Wallace & Tiernan Co., Inc
Welsbach Corp., Ozone Processes Div.

Telemeters, Level, Pump Control, Rate of Flow, Gate Position, etc.:
Builders-Providence, Inc.

Turbidimetric Apparatus (For Turbidity and Sulfate Determinations):
Hellige, Inc.
Wallace & Tiernan Co., Inc.

Turbines, Steam:
DeLaval Steam Turbine Co.

Turbines, Water:
DeLaval Steam Turbine Co.

Valve Boxes:
Central Foundry Co.
James B. Clow & Sons
Ford Meter Box Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valve Inserting Machines:
A. P. Smith Mfg. Co.

Valves, Altitude:
Ross Valve Mfg. Co., Inc.

Valves, Butterfly, Check, Flap, Foot, Hose, Mud and Plug:
James B. Clow & Sons
M. Greenberg's Sons
Rensselaer Valve Co.
R. D. Wood Co.

Valves, Detector Check:
Hersey Mfg. Co.

Valves, Electrically Operated:
James B. Clow & Sons
Kennedy Valve Mfg. Co.
Philadelphia Gear Works, Inc.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.

Valves, Float:
Ross Valve Mfg. Co., Inc.

Valves, Gate:
Dresser Mfg. Div.
James Jones Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Hydraulically Operated:
James B. Clow & Sons
Kennedy Valve Mfg. Co.
Philadelphia Gear Works, Inc.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Large Diameter:
James B. Clow & Sons
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Regulating:
Ross Valve Mfg. Co.

Valves, Swing Check:
James B. Clow & Sons
M. Greenberg's Sons
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Waterproofing
Inertol Co., Inc.

Water Softening Plants:
(See Softeners)

Water Supply Contractors:
Layne & Bowler, Inc.

Water Testing Apparatus:
Hellige, Inc.
LaMotte Chemical Products Co.
Photovolt Corp.
Wallace & Tiernan Co., Inc.

Water Treatment Plants:
American Well Works
Chain Belt Co.
Chicago Bridge & Iron Co.
Dorr Co.
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Pittsburgh-Des Moines Steel Co.
Roberts Filter Mfg. Co.
Stuart Corp.
Walker Process Equipment, Inc.
Wallace & Tiernan Co., Inc.
Welsbach Corp., Ozone Processes Div.

Well Acidizing:
Dowell Incorporated

Well Drilling Contractors:
Layne & Bowler, Inc.

Wrenches, Ratchet:
Dresser Mfg. Div.

Zeolite:
Hungerford & Terry, Inc.
Infilco, Inc.
Permutit Co.
Roberts Filter Mfg. Co.

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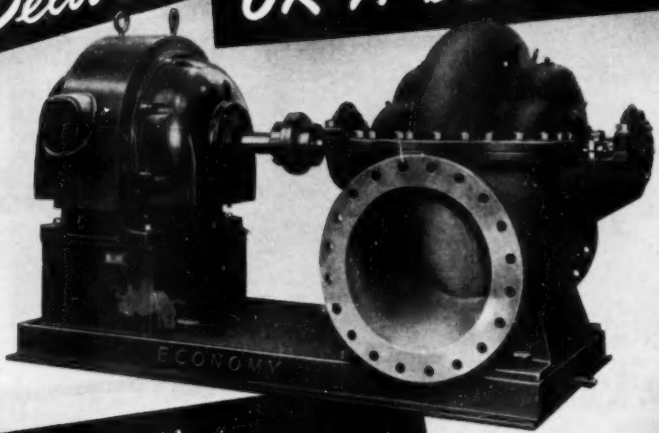

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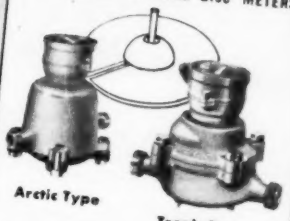

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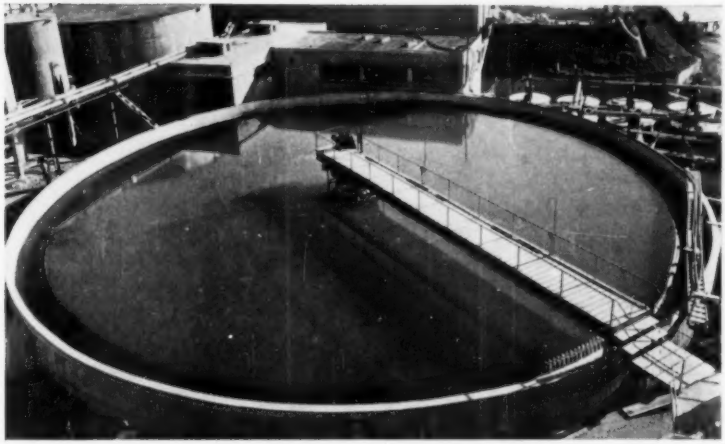

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The Dorrco Hydro-Treator is a high rate, upflow water treatment unit that gives you flocculation, sludge thickening and clarification in a *single*, compact structure. As feed is distributed, heavy, gritty solids quickly settle to the floor of the Flocculator compartment and are raked inward to the central discharge cone. Light, flocculated solids drift into the sludge well, and are thickened as they settle to the discharge cone. Clarified water is overflowed at the surface.

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▲ Pictured above is a typical Hydro-Treator installation removing algae, turbidity and color, and producing clear process water for a South American paper mill. A duplicate unit is located alongside the one shown. Total maximum capacity . . . 25 M.G.D. Turbidity reduction . . . 97% from river water supply.

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